Popular Astronomy.

Vol. XXXVI, No. 3 MARCH, 1928 Whole No. 353

THIRTY-NINTH MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

On the invitation of Yale University the thirty-ninth meeting of the Society was held in New Haven, December 29-30, 1927. It was followed by a meeting of the American Section of the International Astronomical Union on December 31. The program of papers filled the time of the four sessions just not to over-flowing, with comfortable time for discussion. President Comstock presided at the first two sessions and at a part of the third and then asked Ex-President Schlesinger to take the chair. The sessions were held in William L. Harkness Hall. The papers had their usual variety but there seemed to be no dull ones among them. The grouping of a connected series of papers on spectral classification by the Harvard staff seemed to take very well. Something of this kind might well be tried again. The reporters were introduced to Russell, who generously acted as press secretary. According to one observer, he enjoyed the duty very much.

At the business session on Thursday, Comstock reported for the Committee on Incorporation. The word 'The' was deleted from the name of the Society as it appeared in the articles of incorporation, on motion of Shapley, who prophesied that retention of the definite article would logically lead to the abbreviation T.A.A.S. Schlesinger, in announcing the result of the vote, stated that the name of the Society remained the American Astronomical Society. The committee was authorized to proceed with the incorporation.

Max Wolf, Director of Heidelberg Observatory, distinguished especially for his originality and activity in observational astronomy, was elected Honorary Member of the Society. While the constitution permits the election of one astronomer of distinction at each annual meeting there had been no election since 1924 and there are but five other living honorary members.

Fifteen new members were elected, bringing the total enrollment to four hundred fifty.

John Wallace Eckert, Columbia University, New York City.
B. P. Gerasimovič, Harvard College Observatory, Cambridge, Mass.
Jen Hsien Hsu, Rockefeller Hall, Ithaca, N. Y.
Charles Hujer, Yerkes Observatory, Williams Bay, Wis.
Don Julio Bustos Navarette, Casilla 130, Santiago, Chile.
Roger L. Putnam, 297 Union St., Springfield, Mass.
John Rees, "Snowdonia," Victoria Square, Penarth, Glam., South Wales.

Robert S. Richardson, 2847 West 8th St., Los Angeles, Calif.
Charles E. Rogers, Trinity College, Hartford, Conn.
Paul Slavenas, Yale University Observatory, New Haven, Conn.
Werner F. Straubel, Carl Zeiss, Inc., 485 Fifth Ave., New York City.
Ralph N. Van Arnam, Beaver Falls, N. Y.
Reginald L. Waterfield, Johns Hopkins Hospital, Baltimore, Md.
Emma T. R. Williams, Harvard College Observatory, Cambridge, Mass.
Doris M. Wills, Harvard College Observatory, Cambridge, Mass.

A number of the new members were present and soon came to realize what a friendly lot of people the members of the Society are.

After the morning session on Friday the drizzle stopped for a few minutes and the local photographer made his usual attempt to catch the members in a moment of relaxation. This was only partially successful. These attempts will be continued. There is a certain something about the picture which reminds one of the thirty-fifth meeting. The Secretary hopes that he will incur no enmities by his artistic work on the "key." He was in need of relaxation after the meeting and his only purpose was to make identification easy. It is hoped that it will provide something pleasing to everyone.

The key is believed to be correct at the time of going to press. An engraved announcement of a change of name solemnized on December the twenty-seventh was received too late to be given deserved publicity at the meeting, but in time to make the necessary alteration in the key.

Doubtless all local committees rise to the occasion and develop abilities and virtues of which even they themselves were not aware, but this one seemed exceptionally good, and there were many favorable comments. The committee showed admirable restraint in scheduling entertainment, and the blank spaces on the program, filled in according to individual tastes at the Faculty Club, proved to be the best part of it. Some ran to conversation, some to bridge, and some to both. There were some good dancers in the crowd but no one started the Victrola. Some inquired about the "special dinner," but, when questioned, disclaimed any desire to make after-dinner speeches. There were more who inquired where they could get breakfast.

On Friday afternoon Miss Cannon and Miss Furness brought in a happily worded resolution of thanks to our hosts and hostesses. When the Secretary came to read it over he saw the joker: copies were to be presented to those mentioned in the resolution and the committee had mentioned everyone they could think of—but each one really merited special thanks.

The following statement was accepted by the Society with prolonged applause and ordered printed in the report:

> The transfer of the secretarial office has been made a relatively easy matter by the system practiced by the retiring Secretary and by the helpful interest with which he furnished information and advice to the incoming Secretary. An examination of the secre-

tarial records furnishes additional evidence that the retiring Secretary, Joel Stebbins, has set a high standard of efficiency; has invented and perfected noiseless and frictionless methods of operation of the Society machinery; has shown considerate regard for the feelings of others; and in more ways than we shall ever know has worked untiringly and with characteristic good spirit for the success of the Society.

Schlesinger added that being president was an easy job while Stebbins was secretary.

Winter meetings are never as numerously ornamented with wives as those that take place under more dulcet skies—but there were a few such. The following members were present:

R. G. Aitken
Adelaide Ames
L. B. Andrews
Weld Arnold
S. I. Bailey
Ida Barney
Harriet W. Bigelow
S. L. Boothroyd
Benjamin Boss
E. W. Brown
Leon Campbell
Annie J. Cannon
G. C. Comstock
C. C. Crump
C. H. Currier
H. D. Curtis
G. K. Daghlian
R. E. De Lury
R. S. Dugan
J. C. Duncan
J. W. Eckert
W. S. Eichelberger
Priscilla Fairfield
J. W. Fecker
Philip Fox
Jennie V. France
Caroline E. Furness
B. P. Gerasimović
H. W. Geromanos
W. K. Green
Asaph Hall
Margaret Harwood
M. Alberta Hawes
N. B. Hedrick
Laura E. Hill
Helen E. Howarth
Charles Hujer
M. F. Jordan
E. S. King
Michel Kovalenko
Isabella Lange
Florence P. Lewis
Morris Liferock
Hazel M. Losh
C. A. R. Lundin
W. J. Luyten
D. B. McLaughlin
E. S. Manson, Jr.
R. W. Marriott
A. D. Maxwell
J. A. Miller
S. A. Mitchell
H. R. Morgan
C. P. Olivier
G. F. Paddock
Jesse Pawling
Cecilia H. Payne
G. H. Peters
E. C. Phillips
D. B. Pickering
R. L. Putnam
Luis Rodés
C. E. Rogers
H. N. Russell
Helen B. Sawyer
Jan Schilt
Frank Schlesinger
Harlow Shapley
B. W. Sitterly
Paul Slavenas
Frederick Slocum
C. L. Stearns
H. T. Stetson
J. Q. Stewart
James Stokley, Jr.
W. F. Straubel
Helen M. Swartz
A. B. Turner
Peter van de Kamp
Alexander Vyssotsky
R. L. Waterfield
Emma T. R. Williams
Doris M. Wills
R. E. Wilson
E. W. Woolard
J. E. G. Yalden
Anne S. Young

The fortieth meeting of the Society will be held at Amherst College, probably September 11-13; the forty-first, in December, at the American Museum of Natural History.

At the request of the Council, the National Research Fellowship Board has authorized the publication of the following statement:

> Under the auspices of the National Research Council a series of post doctorate fellowships is maintained in the immediate charge of the National Research Fellowship Board for Physics, Chemistry, and Mathematics, and supported upon funds provided by the Rockefeller Foundation. The purpose of these fellowships is to promote the development of research workers in these fields.
>
> Since these basic sciences of physics and mathematics especially

are, however, closely related to the development of astronomy, fellows have not infrequently been appointed to work upon problems lying wholly within one or another of the fields included within the purview of the Board but which may have a further application in astronomical work. The Board desires that it be understood among the astronomers of the country that it considers applications for fellowships from qualified candidates who wish to work upon fundamental problems of mathematics, physics, or chemistry which may have been suggested by or have a later bearing upon research in the comprehensive field of astronomy.

AMERICAN SECTION OF THE INTERNATIONAL ASTRONOMICAL UNION.

On Friday evening small groups gathered in the various crannies of the Faculty Club to prepare for the reports of the American Section. Several members narrowly escaped dismemberment among several committees.

Saturday morning, at 9:30, many of the members assembled under a new guise—as the American Section of the International Astronomical Union, with Shapley presiding, and the Secretary trying to make a complete record of the proceedings. Motions were made and unmade with bewildering rapidity and grew to great lengths before the movers had used all the words they wanted to. The Secretary was usually left to express the spirit of the motion—if he had caught it.

After announcements by the Chairman of the actions of the Executive Committee in appointing technical committees, and in recommending that American astronomers try to attend the meetings of the Astronomische Gesellschaft in Frankfurt and Heidelberg, beginning about July 15, several general resolutions, having to do with the statutes, were discussed and voted on. After the general business, the Section took up the reports of the seventeen technical committees. As twelve of the chairmen are chairmen of the corresponding international committees also, these reports were largely provisional reports of the international committees.

Some of the matters considered were: the mathematical definition of the limits of the northern constellations; the standard unit of stellar distance; the early publication of meridian observations; the marked increase in accuracy of new secondary standards of iron and of the new system of solar standards; observations of latitude variation in the southern hemisphere; an international code for telegrams to contain provision for a brief description of objects; a new catalogue of meteor radiants; publication of old observations of variable stars; the nomenclature of variable stars; the systematic errors of visual and photographic observations of double stars; plans for coöperation in the observation and classification of nebulae; the classification of O-type stars; and the systematic extension of radial-velocity determinations to fainter stars.

This list does not cover the entire science of Astronomy but the rest was at least mentioned during the meeting.

Those intending to go to Leiden should notify the Secretary as soon as possible. Credentials will be issued to the Delegates by the National Research Council. Applications for passports should be made as usual through the local courts.

(To be continued.)

THE NEXT PLANET BEYOND NEPTUNE.

By WILLIAM H. PICKERING.

Introduction.

The seeking and successfully locating in the sky, of the at that time unknown planet Neptune, aided only by means of computations based on the law of gravitation, by the two investigators Leverrier and Adams, has always been considered to be one of the greatest triumphs of mathematical astronomy. While these computations were complex and very laborious, yet the general principles on which they were based are not difficult to understand. The disturbing force of an outer unknown planet, acting on an inner one which is known, may for purposes of explanation be divided into two parts, a tangential and a radial component. These components are represented in Figure 1, the former by a heavy line, the latter by a light one. The abscissas represent the heliocentric longitudes of the known planet, and are therefore analogous to time. They are counted from right to left in the direction in which

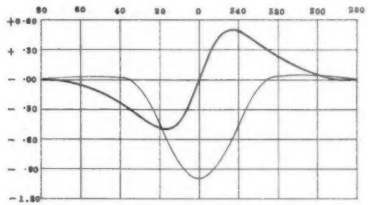


Figure 1.
Tangential and Radial Forces.

the planet moves in the sky. Their origin 0° is taken where the two planets are in conjunction as seen from the Sun. The ordinates represent the disturbing forces acting on the planet. When positive they tend to accelerate its velocity, when negative to retard it.

Let us suppose now that the known planet is approaching the conjunction from the left. The tangential force has no effect on it at longi-

tude 289° in the case for instance of Uranus and Neptune. The latter planet is then only 36° ahead of the former, and begins to draw it forward in its orbit at an ever increasing speed. The maximum pull occurs at longitude 18° before conjunction is reached, but the speed continues to increase until conjunction, when the tangential pull is reduced to zero. Beyond this point the curve reverses, the backward pull reaching its maximum value at longitude 18°, but continuing to retard the planet until 71°. After that a slight acceleration arises as the two planets approach opposition with regard to the Sun. The force is then again reduced to zero, but is later replaced by a slight retarding force, acting until the planet arrives at longitude 289°, the point from which we started. The radial component, which at maximum is twice the tangential, acts most strongly when the planets are in conjunction. It is reduced to zero at 35° on either side of this point, and is of little consequence during the remaining 290° of the orbit. It tends to pull Uranus into a larger orbit, and thus to diminish its velocity. All of these angles vary to a small extent with the relative distances of the two planets from the Sun. When their orbits are widely separated, the forces at opposition tend to approach in intensity those acting at conjunction.

The tangential component is symmetrical about the line of zero ordinates. This is not the case with the radial one, and it seems at first as if the inner planet would therefore constantly recede from the Sun, which we know is not the case. What really happens is that the eccentricity and longitude of the perihelion of its orbit change. While these curves represent the forces acting on the inner planet, they do not represent its changes of velocity, and still less its changes of position. Thus when the radial component is at its maximum intensity at conjunction, it has only fairly begun to pull the known planet outwards, with diminishing speed in its orbit. Again when at conjunction, the tangential component is reduced to zero, the planet under its past influence is then moving at its maximum speed. The action of this component is indeed something like that of gravity acting on the pendulum of a clock. These facts will perhaps partly explain why the computation of the effects produced is a rather complex one.

The idea nevertheless occurred to me many years ago that, since the only marked accelerating effect occurs just before the conjunction of the two planets, by studying the effect of this force on Uranus, Saturn, and Jupiter as perturbed by Neptune, a graphical solution of the problem might be found for any future case, which while of a more or less "rule of thumb" character, would yet avoid many of the complications, and much of the extended labor of the analytical method. This first investigation was made in 1908, and is described in the *Harvard Annals*, **61**, 113. Three principles new to this kind of investigation were introduced into the inquiry. Just as Burnham had shown conclusively that the graphical method was superior to the analytical one

in all preliminary determinations of the orbit of a binary star, so the writer felt it was the best method of investigating the orbit of an unknown planet, where the data at our disposal were so contradictory and uncertain as they were at that time. Since Neptune had shown no appreciable perturbation since the time of its discovery, a curve was plotted with the heliocentric longitudes of Uranus as abscissas and its observed deviations from theory as ordinates. These last were taken for the earlier dates from Leverrier's later investigations of its orbit, and for the later dates from the Greenwich Observations. Following this, the next step was to construct a theoretical curve like Figure 1, showing in general what should be the shape of the curve of a disturbed planet.

The second principle introduced was to modify in a graphical manner the accepted elements of the orbit of Uranus, as deduced by Leverrier, so that the majority of the deviations should resemble as closely as possible the theoretical curve. In carrying out this principle we adopted a plan first suggested by Sir John Herschel (*Outlines of Astronomy,* 533). If on a curve plotted like Figure 1, but with observed deviations substituted for forces, we incline the line of zero ordinates, those at one end will become longer and at the other shorter. This is equivalent to a slight change in the period of the planet. If we wish to modify the eccentricity and the longitude of perihelion of the accepted orbit, we may do so by replacing the straight line by a curve of sines, whose period is 360°. This curve is analogous to the inclined circle or preliminary ellipse used in determining the orbit of a double star. Countless modifications thus become possible, anyone of which may be correct, and one of which doubtless would be more accurate than the accepted orbit.

The third and perhaps the most important principle that we introduced, was to make use of the perturbations of some of the other planets. It was then shown that the perturbations of Saturn by Neptune, even in the days of Leverrier and Adams, were clearly marked, and, had it occurred to either of these astronomers to make use of them to determine the period of the unknown Neptune, they would never have made the mistake of assuming the correctness of Bode's law. This mistake caused both of them not only to assign a wrong distance to the unknown planet, but also to assign high ellipticities to its computed orbit, and thus to obtain results which bore no resemblance to the nearly circular orbit of Neptune.

In carrying out our investigation, as described in the above mentioned publication, after constructing the curve of forces similar to Figure 1, which is a revision of Figure 15 of that publication, the next step was to plot the deviations of Uranus actually observed from its accepted orbit as given by Leverrier, and then to modify these deviations by means of an inclined sinusoid in such a manner as to cause them to resemble as closely as possible Figure 15. These curves are there

given in Figures 11 and 12. In order to make this matter clearer, however, I have copied the later portion of these two curves in Figures 2 and 3 of the present publication. In both cases the heliocentric longitudes are given at the top of the figure, the dates at the bottom, and the deviations in seconds of arc at the left hand, a positive deviation indicating that the observed planet is ahead of its computed place. The heavy horizontal line of Figure 2 represents the at that time *accepted* orbit which Uranus was expected to follow. It was based in part on observations going back as far as 1690, when Uranus was first observed

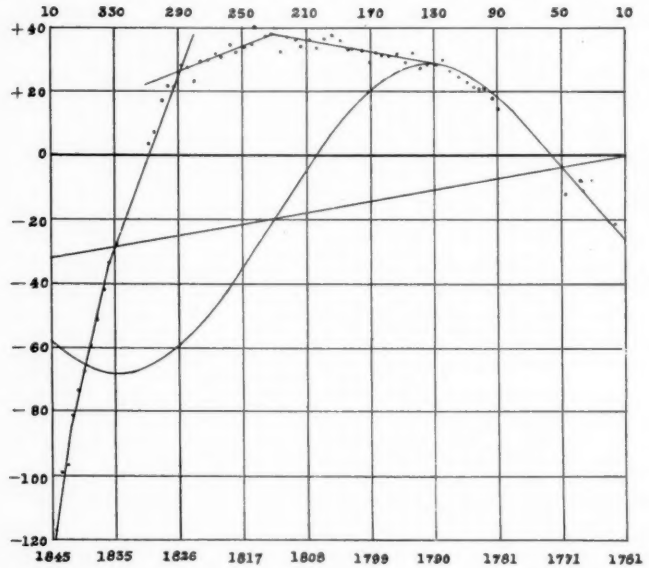


FIGURE 2.

ACCEPTED ORBIT OF URANUS PERTURBED BY NEPTUNE.

by Flamsteed, who supposed it to be an ordinary star. The fact that other accepted orbits resembling this one were very unsatisfactory was noted by several astronomers before the time of Leverrier and Adams. On examining Figure 2 we notice at once that immediately after the year 1825 the deviations fall off sharply, indicating as we now know a strong backward pull on the planet by some at that time unknown body. If we measure the ordinates of each observation, not from the zero line but from that portion of the sinusoid having the same abscissa, we shall obtain the series of revised ordinates with which Figure 3 is plotted. This we shall call the *revised* orbit. In this previous investigation, the earlier observations of Uranus not shown here gave important aid in the selection of the sinusoid. The heavy line in Figure 3 corresponds

to the axis of the curve in Figure 1.

If now we compare these two curves, we see at once that there is a striking resemblance between them. The maximum force, as we might have expected, produces the maximum effect, and in both curves these maxima are followed by a very sharp and sudden drop. This close resemblance greatly simplifies our problem, and when we find in what longitude this maximum deviation of the revised orbit occurs, we have taken the first step in finding the planet, and locating its orbit. It may be stated here, as shown in the earlier publication, that a material

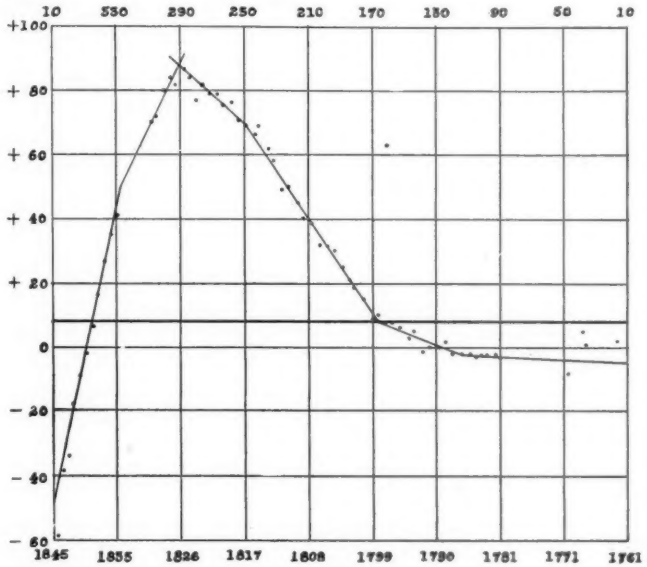


FIGURE 3.

REVISED ORBIT OF URANUS PERTURBED BY NEPTUNE.

change in the position and inclination of the sinusoid produces but little effect on the position of this maximum deviation. In our later investigations, instead of using the sinusoid to produce a curve resembling Figure 1, we have used it to produce a curve which, prior to the sharp rise preceding the maximum, shall resemble a straight horizontal line as nearly as possible. This we have found in practice a better method, and as far as locating the maximum deviation is concerned the results are identical. The reason for this steadfastness of the maximum deviation is that it coincides with the maximum change of velocity in the curve (Figure 2) representing the accepted orbit. In fact in the present instance both of these points are clearly shown, so that the construction of the curve representing the revised orbit is of use mainly in

order to illustrate the principle, the application of which is found to be necessary in the cases where the perturbation is less marked.

An important difference between Figures 1 and 3 must now be mentioned. While it is natural that the curve of deviation, or displacement, should resemble the curve of force producing it, it is also natural that the maximum displacement should occur some time after the maximum force has acted, and this also we find to be the case. The heliocentric conjunction of Uranus and Neptune as we now know occurred in 1821.5 in longitude 273°.1. The maximum deviation we see by Figure 3 occurred 17° later, in 1826.5, longitude 290°. But as shown at the beginning of this article the maximum tangential force occurred at 18° before conjunction was reached, or 35° before the maximum deviation. I give these figures here merely to show that the longitude of the maximum force, and the longitude of the conjunction have nothing whatever to do with the problem in hand, which depends solely on the longitude of the maximum displacement of the known planet. What relation this longitude has to the longitude of the one that is unknown on the date of maximum displacement is the *crux* of the whole problem, and will be dealt with later.

Unexplained Perturbations of the Known Planets.

We will now turn our attention to the planet Neptune. In addition to the original publication, two brief ones relating to its perturbations have been published, one in *Harvard Circular* No. 215, and the other in the *Harvard Annals*, **82**, 49. The latter is partly historical, but neither contains any data to which we need refer further in the present article. The first three columns of Table I give the deviations of the earlier ob-

TABLE I.

Early Deviations of Neptune.

Date	H.L.	Newcomb	Correction	Revised
1795	216°	—2″.05	—1″.54	—0″.51
1848	330	—0.27	—0.46	+0.19
1852	339	+ .26	—0.62	+0.88
1856	348	+ .07	—0.83	+0.90
1860	356	— .52	—1.04	+0.52
1864	5	— .37	—1.32	+0.95
1868	14	+ .12	—1.60	+1.72
1872	23	— .30	—1.91	+1.61
1876	32	+ .20	—2.24	+2.48
1880	41	+ .32	—2.56	+2.88
1884	50	— .36	—2.89	+2.53
1888	59	— .30	—3.21	+2.91
1892	68	+ .25	—3.52	+3.77
1896	77	—0.28	—3.80	+3.52

servations of Neptune from Newcomb's theory, as deduced by him, and published in the *Astronomical Papers of the American Ephemeris*, **7**, 419. Table II contains data which have accumulated since that time. The first three columns give the mean date, the heliocentric longitude, and the deviation of the planet from Newcomb's theory, as deduced

TABLE II.

LATER DEVIATIONS OF NEPTUNE.

Date	H.L.	Green.	Wash.	Har.	Mean	Dev.	Corr.	Revised
1904.1	95°	+0″.08	—0″.54	....	—0″.23	....	—4″.29	+4″.06
05.1	97	+0.70	—0.67	....	+0.02	±0.68	—4.34	+4.36
06.1	99	+0.08	—0.60	....	—0.26	±0.34	—4.38	+4.12
07.1	101	—1.05	....	....	—1.05	....	—4.42	+3.37
08.1	104	—0.87	—0.81	....	—0.84	±0.03	—4.48	+3.64
09.1	106	—0.73	—1.17	....	—0.95	±0.22	—4.52	+3.57
10.1	108	—1.02	—1.09	....	—1.06	±0.04	—4.56	+3.50
11.1	110	—1.39	—0.88	—0.87	—1.05	±0.23	—4.59	+3.54
12.1	113	—1.04	—1.02	....	—1.03	±0.01	—4.64	+3.61
13.1	115	—0.97	—1.12	....	—1.04	±0.08	—4.67	+3.63
14.2	117	—1.17	—1.26	....	—1.22	±0.04	—4.69	+3.47
15.2	119	....	—1.33	—1.76	—1.54	±0.22	—4.72	+3.18
16.2	122	—2.14	—1.07	....	—1.61	±0.54	—4.75	+3.14
17.2	124	—2.01	—1.15	—2.19	—1.78	±0.42	—4.77	+2.99
18.2	126	—2.28	—1.43	....	—1.86	±0.43	—4.79	+2.93
19.2	128	—2.68	....	....	—2.68	....	—4.81	+2.13
20.2	130	—2.37	....	....	—2.37	....	—4.82	+2.45
21.2	133	—2.76	....	....	—2.76	....	—4.84	+2.08
22.2	135	—1.84	....	....	—1.84	....	—4.84	+3.00
23.2	137	—2.57	....	....	—2.57	....	—4.85	+2.28
24.2	139	—3.05	....	....	—3.05	....	—4.85	+1.80

from the Greenwich Observations. We have reversed the signs, so that the results shall give the observed minus the computed values. The fourth column gives certain of the Washington observations similarly deduced, except as to sign, which was unnecessary, kindly sent me by letter several years ago, but received too late to be used at that time. The fifth column gives the results of some measures of Harvard plates made by Professor Russell, the sixth the means of these three columns, and the seventh their average deviations.

This table begins with the year when Newcomb's orbit first came into general use. For three years, until 1907, the observations followed it in a satisfactory manner, but beginning with that date all the observations show that the planet is gradually falling behind its computed place. The second and sixth columns of this table, and the second and third of Table I, have been plotted, and the results are shown in Figure 4, which may be compared with the analogous curve for Uranus shown in Figure 2. The resemblance is fairly marked, and it is believed that the cause is the same, namely an at present unknown outer planet. The most striking difference is that while the scale of the abscissas is the same, the deviations in the present instance are only one-twentieth the size of those of Uranus. It is clear that the unknown, which we shall here designate, as in former publications, by the letter *O*, is either very small or very remote, as compared to Neptune. We shall see later that the former is the true explanation, and this view is confirmed by the sharpness and well defined character of the angle at the point of maximum change of velocity in longitude 95°.

In my earlier paper it was shown, based on the assumed longitude of planet *O* and its rate of motion as determined from the perturbations

of Uranus, that Neptune would soon reach a portion of its orbit where the effect upon it of the unknown planet would become evident. At that time no direct evidence of any such perturbation of Neptune itself had been secured. The mean of the last available observations was

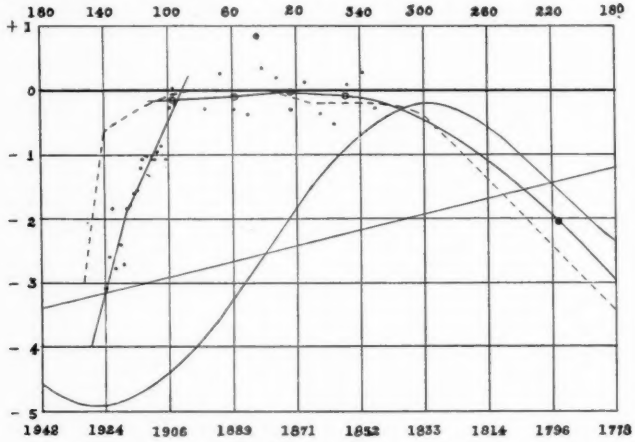


FIGURE 4.

ACCEPTED ORBIT OF NEPTUNE PERTURBED BY PLANET *O*.

Newcomb's value of longitude 77°, for the year 1896, shown on the curve. A few years later, however, as the observations made at different observatories were gradually reduced, clear evidence of such a result became manifest. Indeed by 1910, as we see by Table II, Neptune had already fallen 1″ behind its computed place in Newcomb's orbit. The dotted line in Figure 4 represents the predicted perturbation of Neptune taken from Figure 31 of my original publication. We shall see a little later why we did not place the angle at a rather earlier date than 1924.

The observations of Uranus up to 1846, which is as far as Leverrier's earlier table goes, extend through nearly two revolutions of the planet, those of Neptune through 1924, to only three-quarters of a revolution. It was therefore appreciably more difficult to pass a satisfactory sinusoid through the latter series. The heavy horizontal line in Figure 4, as in Figure 2, represents the accepted orbit from which the deviations occur. Judged by the latter, it is expected that they will continue to increase to at least double their present amount, and perhaps more. The last two columns of Tables I and II give the computed ordinates of the sinusoid, and the resulting ordinates of the revised orbit shown in Figure 5, which may be compared with the analogous curve for Uranus given in Figure 3. Since the earlier observations of Neptune are somewhat scattering, they have been grouped in sets of two to five, and their means indicated by small circles. It was not in general convenient to

use the same grouping in both figures. The heavy line in Figure 5 corresponds to the sinusoid itself. From Figures 4 and 5 we conclude that the maximum deviation of Neptune occurred in 1904.2, in longitude 95°.

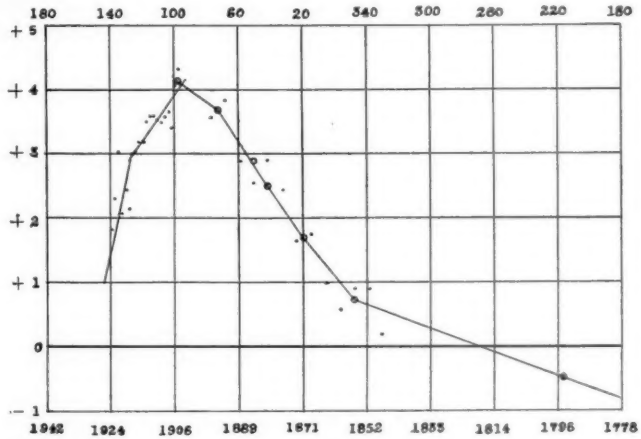


FIGURE 5.

REVISED ORBIT OF NEPTUNE PERTURBED BY PLANET *O*.

Since Newcomb's orbit of Neptune is based on observations of the planet extending from longitude 216° only to 77°, as shown in Figure 4, it obviously now needs correction. The inclined line of that figure falls 2″.17 in 360°, which means that the planet on the whole keeps falling behind its computed place, and therefore that its period needs to be increased. It is in fact 2.42 hours longer than Newcomb supposed. The origin of the sinusoid is taken at 220°, and its amplitude at 1″.75. Since the perihelion of the orbit lies in longitude 44°, it becomes evident to any computer that, while the longitude of perihelion of the orbit is nearly correct, a small diminution will be necessary in the adopted value of the eccentricity.

Let us now turn again to the planet Uranus, and see what indication it gives of any perturbation by planet *O*. When Leverrier published his second theory of Uranus, allowing for its perturbation by Neptune, and carrying the planet through the year 1877, he published with it the various deviations from his theory since the first observation in 1690. Newcomb did the same for Neptune with regard to his own theory. His theory of Uranus is far better than that of Leverrier, and the observations on which it is founded extend to a later date, but he never published its deviations. I asked him once why this was not done, and he replied that he regretted it deeply himself, but that he was retired by the United States Government on reaching the age limit for Naval

Officers, before he had had an opportunity to prepare the work for publication. This was certainly most unfortunate. As a result we have to depend now for perturbations on modifications of Leverrier's theory by means of later observations discussed by two private individuals.

My result was obtained graphically by means of the sinusoid method. I found it impossible to straighten out the observations prior to 1836, and made no attempt to do so, but indicated all of them on the curve Figure 24 of my original publication, where all the necessary data

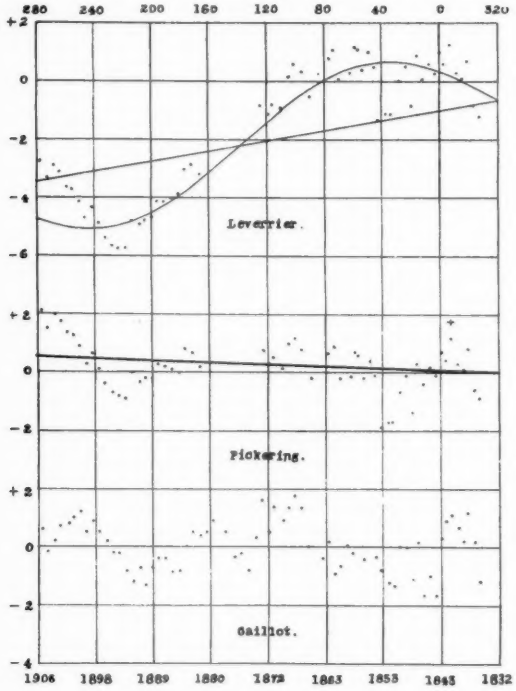


FIGURE 6.

ACCEPTED AND REVISED ORBITS OF URANUS PERTURBED BY *O*.

are given. Oddly enough at about the same time M. Gaillot published an analytical reduction in the *Annals of the Paris Observatory,* **28.** Prior to 1836 he combined the observations into groups of three or four, uniting positive with negative observations where possible, and omitting the larger deviations altogether. Between 1873 and 1882 he introduced seven observations to which I did not have access. He also substituted more modern values for the masses of the larger planets than those used by Leverrier in 1877. This last, however, naturally did not greatly affect the result, as we see by Figure 6, where a plot has been made of

that portion of the two curves since 1835, where the observations are similarly treated. That both of these curves are an improvement on Leverrier's result, also shown in the figure, may be seen at a glance. Gaillot's results are taken from the curve given in the *Memoirs of the Lowell Observatory,* I, Plate 2, and using Leverrier's longitudes. The average deviations of a single observation on the three curves are: Leverrier $\pm 2''.14$, Pickering $\pm 0''.67$, Gaillot $\pm 0''.69$. The graphical method that I employed is obviously far quicker than the analytical one, and one can see now that had I inclined the axis of the sinusoid at a slightly different angle, as shown by the heavy line, the average deviation would have been still further reduced. In fact it now proves to be $\pm 0''.64$.

Accepting the statement that the perturbation curves for Neptune, given in Figures 4 and 5, are due to an unknown planet, whose orbit lies outside that of Neptune, and recalling that Uranus has now been under observation during more than two and a half revolutions, it is clear that it must during that interval have passed the unknown body at least once, and perhaps twice. Uranus passes Neptune after a trifle over two revolutions, in 171.4 years. It passes a remote body like a star in 84.0 years. Let us now see if any of the maxima shown on either Gaillot's or my curve will give a plausible orbit for the unknown planet. Referring to Figure 6, my curve contains two appreciable maxima with regard to the heavy line, one at either end, and two less marked ones between them. The last maximum shown is the first one that we shall consider. It really occurred a little later than 1906, but as Uranus in that year was in longitude 277°, or nearly opposite the place of Neptune, in 1904, it is clear that the same outer planet cannot have been in conjunction with both of the known ones. It is true, however, as we have already seen, that a minor perturbation occurs when two planets are nearly in opposition, although such an effect is usually a comparatively small one. It is possible therefore that *O* has at least contributed to the maximum of 1906.

In order to render this matter a little clearer, we have prepared Figure 7, where the innermost circle represents the orbit of the Earth, and the four heavy circles, drawn to scale, represent the orbits of the four outer planets. The two black dots near longitude 90° represent the computed positions of Neptune and *O* in 1904. The position of Uranus in 1906 is shown by a short line crossing its orbit near longitude 270°. The next maximum that we shall consider is that of 1867. It is shown on all three of the curves of Figure 6, and is the most marked one of all according to Gaillot. It is no wonder then that he, and following him Lowell, thought it of the first importance in the detection of the unknown planet. I too made the same mistake in my former paper, but for a different reason. I was misled by an earlier erroneous observation of Uranus, which with the perturbation of 1867 gave a plausible period for the unknown. On my curve, Figure 6, counting from the

heavy line, this maximum is the third in importance. Its longitude is 101°, and its position is shown in Figure 7 by a short line on the orbit of Uranus marked with the date. If Uranus passed the unknown in 1867, and Neptune was disturbed by it in longitude 95°, in the year 1904, it is clear that during these 37 years either the unknown must have retrograded 6°, or at least, after allowing for certain corrections to the longitudes, have remained stationary. This maximum therefore does not give a plausible result. The real position of *O* at this time is shown in Figure 7 by a short line marked with the same date.

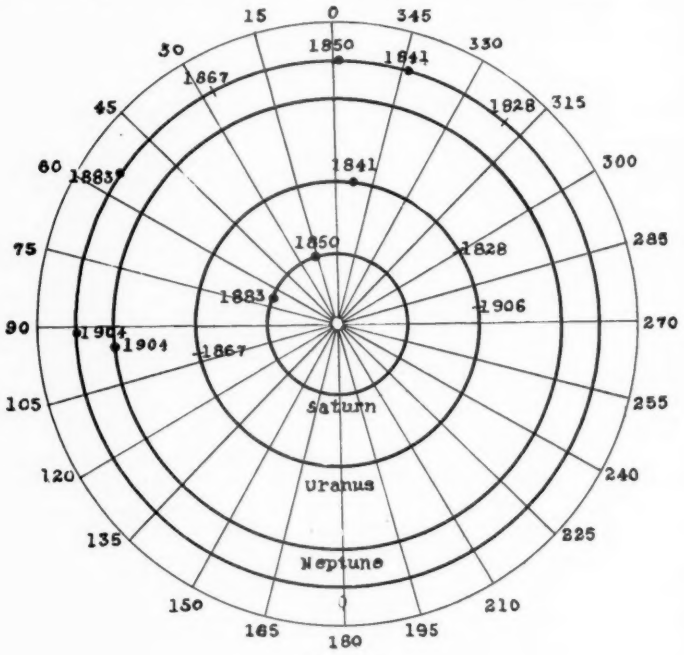


FIGURE 7.

LONGITUDES OF THE OUTER PLANETS.

Let us now go back to the maximum of 1841, when Uranus was in longitude 353°. This is shown on all the orbits of Figure 6, although Gaillot records a slightly higher point three years earlier. If this is the real perturbation, then *O* must have moved about 102° in 63 years, or at the rate of 1°.6 a year. Since Uranus moves 4°.3 per year, and Neptune at the rate of 2°.2, this result appears plausible (See the two dots in Figure 7 marked 1841). The next earlier possible maximum, depending on a divergent observation of a single year, was in 1828, when Uranus was in longitude 300°. This would give a rate of motion of

2°.1, or about the same as that of Neptune. This again is improbable. The positions of the two planets are shown as before by short lines in Figure 7. Earlier maxima would give still higher rates of speed. Therefore in any case the real maximum must lie between the years 1828 and 1867. Consequently of all the possible maxima found by either Gaillot or myself, that of 1841.7, longitude 353°, alone appears probable. Moreover on both of the curves the maximum is followed by a sharp minimum, the characteristic sign of a conjunction of two planets. Had this date been selected in my former paper for the maximum due to *O* instead of that of 1867, the predicted date for the perturbation of Neptune shown by the dotted line in Figure 4 would have come still nearer to what we now believe to be the fact.

Let us now see what can be done with the planet Saturn. It would seem at first as if a planet relatively so near the Sun, and so massive as Saturn, could hardly experience any appreciable perturbation by a planet so small and so remote as *O*. On the other hand Saturn has been accurately observed in all portions of its orbit since 1829, when Hill's very accurate tables begin. Doubtless he did not think that earlier observations were worth reducing. The fact that three conjunctions of this planet with *O*, with their corresponding perturbations, must have occurred since that date is certainly an enormous advantage which it possesses over both Uranus and Neptune, each of which shows only one perturbation. The fact that the observations fully confirm Hill's period without further appreciable reduction is another advantage. The correction appears to be only 0″.14 after 57 years, indicating that his period is a trifle too long.

There are three things which the perturbations of Saturn might enable us to do: First to confirm the position of *O* as derived from the perturbation of Uranus. This is fundamental; second to determine, if possible, whether the orbit of *O* is appreciably eccentric, and then to make an estimate of its eccentricity and perihelion; third to aid us to form some idea of the mass of the planet, and thus secure an estimate of its brightness. While it is possible to determine with about equal accuracy, although unequal certainty, the years in which these known outer planets are most perturbed, our results dependent on Saturn are much less accurate than those for the other two. This is because, while Neptune moves but two degrees in the course of a year, and Uranus four, Saturn moves over twelve.

The curve for Saturn based on Hill's orbit has already been given in my original publication (Figure 29) with accompanying data, but is repeated here in Figure 8, merely reducing in this case the amplitude of the sinusoid by one-half. This change has no effect on the positions of the maxima, nor does it alter the appearance of the curve itself materially. It does give it, however, a more plausible shape. The upper line gives the original plot taken from Hill's tables, and the later Greenwich observations. The lower line gives the positions as corrected by the

sinusoid. There is only one maximum, that of 1850.8, longitude 18°, which could possibly relate to the unknown planet as located by Uranus in 1841, near longitude 355°. This one is the mean of a number of observations. It is sharply marked, and of the proper shape, being followed as we see by a deep minimum. It confirms the position of *O* as indicated by Uranus in a satisfactory manner, as we shall see later, and thus meets the first and most important of our three requirements. The irregularities of Saturn's orbit, as indicated in Figure 8,

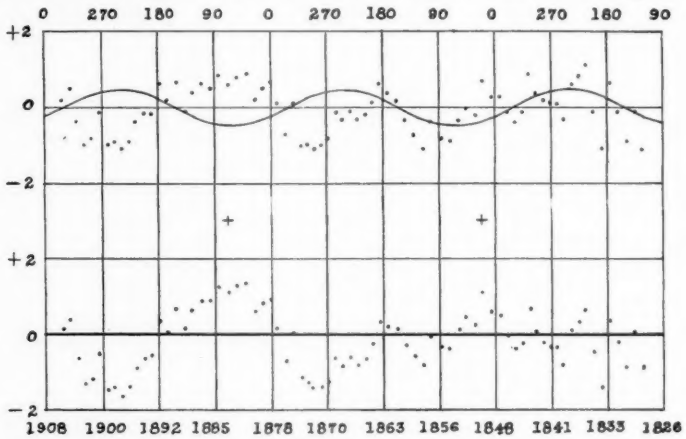


FIGURE 8.

ACCEPTED AND REVISED ORBITS OF SATURN PERTURBED BY *O*.

are so large in proportion to the perturbations caused by *O*, that with this exception, which is obvious, they are rather difficult to detect. From the longitudes and dates already given of Uranus and Neptune, it is evident that the period of *O*, if moving in an approximately circular orbit, but little exceeds 200 years. From this fact we readily derive that Saturn must overtake it once in about 34 years. This eliminates a very large proportion of the deviations recorded from further consideration. For the two remaining perturbations therefore, after selecting the few deviations possible, we shall eliminate the improbable ones by the use of the characteristic sharp fall that follows every true perturbation. The first of the three, that of 1850.8, as we see by the curve, is followed by a fall of 0″.8. The computed value is 0″.83. This is rather excessive, since the following deviation is a little too small, as is shown by the figure. The next possible maxima are those of 1881 and 1882, longitudes 40° and 53°. These are not followed by a sufficient fall, and moreover do not meet the requirements in longitude for a possible orbit. This last requirement is fairly well fulfilled, however, by the next maximum, that of 1885.0, longitude 81°, and the fall immediately following it in this case is 0″.35.

Owing to a change in the form of publication employed, the assistant who was in charge of forwarding the data failed to send me any observations of Saturn after 1914. This was most unfortunate. Captain Eichelberger of the *American Ephemeris* has, however, kindly furnished me with a very complete set of preliminary determinations, locating the planet from 1900 to 1922. In this place in expressing my appreciation to him, I wish to remark, not at all in criticism, but merely as a suggestion, that it would be very desirable if the authorities of the Naval Observatory would issue besides the *Ephemeris* and its irregular publications, some of its other results annually, as is done by Greenwich. For any research like the present one, this Greenwich publication is invaluable. Washington willingly, and apparently gladly, gives all the data asked for in full. But there is so much that one wants, sometimes immediately, that one hesitates to ask Washington for all of it, while Greenwich gives everything annually nearly up to date.

Table III deals with the third perturbation of Saturn. The first column gives the date when the Greenwich observations were taken, as far as they go. The last ones I have were taken in late December, 1914, and are therefore entered under the nearest date, 1915.0. After that the dates are for the Washington observations. The earlier dates will also serve for Washington, since they generally differ from those of Greenwich by less than 0.1 of a year. The second column gives the corresponding heliocentric longitudes of Saturn, the third the Greenwich deviations, and the fourth those of Washington, both reduced from seconds of right ascension to seconds of arc of longitude. The first four results for Greenwich are copied from my original publication, in which I gave the results only to tenths of a second.

The Washington results are rather curious in a way. A remarkable rise of 1″.62 occurs between 1906 and 1907, and a far more remarkable fall of 2″.18 between 1910 and 1912. The first is partly confirmed by Greenwich, which during the same interval records a rise of 0″.70, but for the second, instead of a fall, Greenwich records a small rise of 0″.26. No observations were secured at Washington in 1911, but after that date they employed a different kind of eyepiece, of what is known as the "reversing prism" form. This gave remarkably accordant results for the declinations, reducing the successive differences by more than one half. For the right ascensions on the other hand the differences were increased by 50 per cent. If all the Washington longitudes since 1911 were increased by 1″.5 they would agree much better with the results of the previous years throughout Hill's orbit, going back to 1829. It would also greatly reduce the extraordinary fall of 2″.18 above noted, and finally, agree much better with the three Greenwich observations sent to me. These last show no marked deviation since the five preceding 1911.

The fifth column gives the differences between Greenwich and Washington, the sixth the later Washington observations increased by 1″.5,

the seventh, after adopting this correction, the mean values for Greenwich and Washington, and the eighth their deviations. The ninth column gives the ordinates of the adopted sinusoid, and the last the resulting residuals,—the final results. It has not seemed to me to be

TABLE III.

THE THIRD PERTURBATION OF SATURN.

Year	H.L.	Green.	Wash.	G—W	Corr.	Mean	Dev.	Sin.	Res.
	°	″	″	″		″	″	″	″
1900.5	272	—0.5	—0.56	+0.06		—0.53	±0.03	+0.42	—0.95
01.5	284	—1.6	+0.56	—1.66		—0.27	±0.83	+0.37	—0.64
02.6	296	—1.3	—0.42	—0.88		—0.86	±0.44	+0.28	—1.14
03.6	307	—0.6	—0.44	—0.16		—0.52	±0.08	+0.20	—0.72
04.6	318	+0.78	—0.14	+0.92		+0.32	±0.46	+0.10	+0.22
05.7	329	—0.40	0.00	—0.40		—0.20	±0.20	0.00	—0.20
06.7	342	+0.38	—0.64	+1.02		—0.13	±0.13	—0.11	—0.02
07.8	354	+1.08	+0.98	+0.10		+1.03	±0.05	—0.22	+1.25
08.8	6	+0.87	+1.14	—0.27		+1.00	±0.14	—0.31	+1.31
09.8	20	+1.04	+1.63	—0.59		+1.34	±0.30	—0.39	+1.73
10.8	33	+0.49	+1.44	—0.95		+0.96	±0.48	—0.45	+1.41
11.8	47	+1.15	....	....		+1.15	....	—0.49	+1.64
12.9	61	+0.75	—0.74	+1.49	+0″.76	+0.76	0.00	—0.50	+1.26
13.9	75	+0.19	—0.57	+0.76	+0.93	+0.56	±0.37	—0.48	+1.04
15.0	89	+1.20	—0.71	+1.91	+0.79	+1.00	±0.20	—0.44	+1.44
16.0	103		—0.83		+0.67	+0.67		—0.37	+1.04
17.0	117		—0.86		+0.64	+0.64		—0.27	+0.91
18.1	131		—1.32		+0.18	+0.18		—0.16	+0.34
19.1	145		—1.07		+0.43	+0.43		—0.04	+0.47
20.2	159		—1.26		+0.24	+0.24		+0.08	+0.16
21.2	171		—1.62		—0.12	—0.12		+0.18	—0.30
22.2	184		—1.63		—0.13	—0.13		+0.28	—0.41

worth while to publish the curve based on the second and last columns, since as to clearness it adds little to what has already been shown in Figure 8. The obvious maxima in 1909, 1911, and 1915, indicated in the last column of the table, are many degrees of longitude too early to be consistent with the perturbation of Neptune in 1904. The most marked fall in the whole of the last column of figures, 0″.57, which is as above stated the distinguishing mark of a perturbation, follows the year 1917. It so happens that it occurs in very nearly the right longitude as compared with the perturbation of Neptune. We shall therefore accept it as the real perturbation, although we should not otherwise have picked it out as such, from an inspection of the curve.

While it cannot be claimed that these last two perturbations are convincing by themselves, yet they are perhaps as marked as we could properly expect, considering the great irregularities of the curve, the obviously small mass and great distance of O, and the great mass of Saturn. What is claimed for them, however, is that if we accept the perturbations obtained from Neptune and Uranus as real, and recall the fact that three perturbations of Saturn must necessarily have occurred, then these are the most likely ones that can be found.

THE ORBIT.

Having now located in time and in longitude five points on the orbits of three different known planets, our next step will be to locate the unknown one on these five dates. To do this we will return to a consideration of the early perturbation of Uranus by Neptune. The maximum as we have already found occurred in 1826.5, in longitude 290°. The longitude of Neptune on this date was 281°.9, or 8°.1 behind Uranus. In Figure 9, copied from Figure 17 of our original publication, let

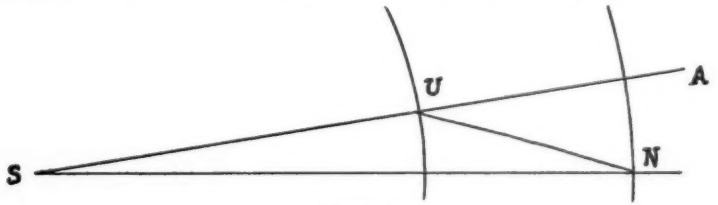


FIGURE 9.

CORRECTION FOR LONGITUDE OF *O*.

S. U, and N represent the Sun, Uranus, and Neptune respectively. On this date the angle at S was 8°.1. The distances of Uranus and Neptune were 19.6 and 30.2 and consequently the angle at U was 157°.55. It was shown that this angle was independent of the masses of the two planets, and also within wide limits, of their respective distances from the Sun. Accepting this angle therefore as a constant, and knowing the distance of *O*, which at first must be assumed, and obtained by approximation, we can compute the angle at S for any known planet. In Table IV the first five columns give the name of the planet, its date of maximum perturbation, its distance, longitude, and longitude corrected for precession to 1900. On account of the fact that Uranus and Neptune occupy nearly the extreme dates, and also on account of the

TABLE IV.

LONGITUDES OF *O*. CIRCULAR ORBIT.

Planet	Date	Dist.	Long.	Long. (1900)	Corr.	*O* Obs.	*O* Com.	O — C	Year
Uranus	1841.7	20.1	353°	353°.7	— 9°.9	343°.8	343°.8	0°.0	0.00
Saturn	1850.8	9.4	18	18.7	—16.6	2.1	359.5	+ 2.6	+0.21
Saturn	1885.0	9.0	81	81.7	—16.8	64.9	58.3	+ 6.6	+0.54
Neptune	1904.2	29.9	95	95.0	— 3.6	91.4	91.4	0.0	0.00
Saturn	1917.0	9.1	117.2	117.0	—16.8	100.2	113.4	—13.2	—1.08

assumed greater certainty and accuracy of their maxima, the positions of these planets were adopted as correct, and a circular orbit passed through them. This gave as a final result, after making the above described approximations and correction, a period of 209.2 years, corresponding to a distance of 35.23 units. Based on this latter value the corrections given in the sixth column of the table were computed, giving

the "observed" longitudes of *O* contained in the seventh. The mean annual motion of *O* is 1°.721, which gives the "computed" longitudes recorded in the eighth column, and the differences given in the ninth. Since the mean annual motion of Saturn is 12°.22, these residuals may be expressed in years, and this has been done in the last column.

Since Saturn is necessarily observed only at intervals of about a year, the second figure in this column is all that could be reasonably desired. The third figure would agree equally well whether the observed date of the perturbation was 1884 or 1885. The last residual would have been 0.08, had we selected 1918 instead of 1917 as the year of maximum perturbation. That 1918 will not do at all, if we accept the recorded deviations, will be readily seen by an inspection of the last column of Table III. It is in fact, if the observations are correct, not followed by a sharp fall, but by a slight rise. It would not be surprising, however, if an accidental error of 0".6 had been made in the observations, which would have been sufficient to make 1918 instead of 1917 the year of the maximum perturbation. It is certain that no other date would do. We are perhaps fortunate if only one of the three dates selected for Saturn is in error. A really reliable result here would have given us an arc of 130° of the orbit of *O*, which should have enabled us to obtain a pretty good idea of its elements. It is a pity that the Washington observations during the period of this perturbation are only preliminary, and that we have no Greenwich observations at all, to serve as a check, for it is evident that greater accuracy is required for this work than is permitted by the observations of any one locality.

The difference between the mean distances of Neptune and *O* is less than half as great as that between Neptune and Uranus. This might seem at first quite close, but on the other hand it is 5.16 units, or practically identical with that of Jupiter from the Sun. It has always been a matter of surprise to astronomers that so distant a planet as Neptune should have an orbit so nearly circular, $e = 0.0086$, exceeded in this respect only by Venus, and that but slightly. The eccentricities of Saturn and Uranus are 6 and 5 times as great respectively. It is possible that the little planet *O* by its eccentricity may furnish in some at present unforeseen way the explanation. Assuming a circular orbit for the moment as correct, we find that in 1928.0 the computed heliocentric longitude of *O* should have been 132°.4. If located in the ecliptic, its position should then have been near $\alpha\ 9^h\ 00^m$, $\delta + 17°$. Opposition should have occurred on February 2.

While we have no certain evidence that the orbit of *O* differs greatly from a circle, yet the residuals in the last column of Table IV imply eccentricity. The fact that the planet is small, and is located not very far from Neptune while at a considerable distance from the Sun, also leads us to believe in an elliptic orbit, analogous to that of Hyperion as influenced by Titan. If so, we might naturally expect that its recent nearness to Neptune would imply that its mean distance was greater

than that above stated. We should therefore naturally infer that it had recently been near perihelion. Such, however, proves not to be the case. In fact the observations indicate that the planet has but recently passed aphelion. An appreciably shorter period than that already found is therefore required. Our first trial was one of 180 years. This too was seen to be much too long. The next trial was that of the period of Neptune, namely 164.8 years. This was found to give a satisfactory result, and at once implied that *O* was really not an exterior, but a com-

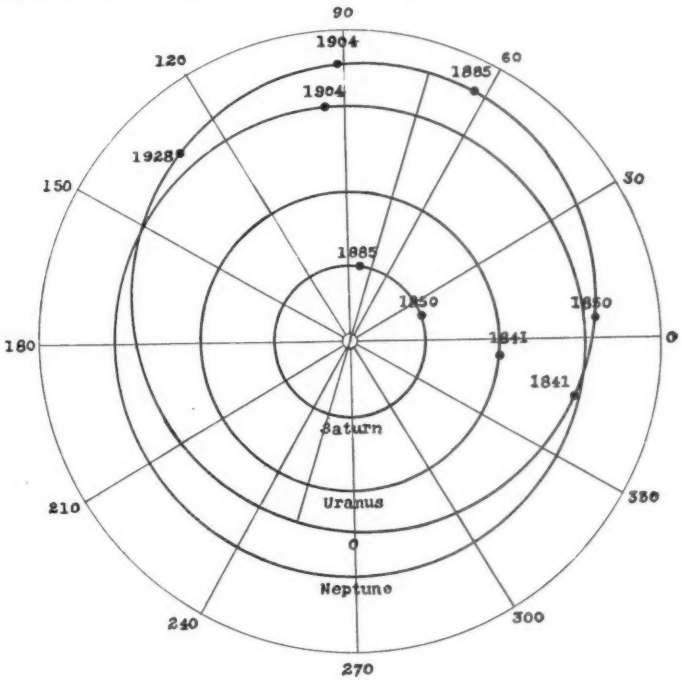


FIGURE 10.
ELLIPTICAL ORBIT OF *O*.

panion planet to Neptune, the case being analogous to the sixth and seventh, and to the eighth and ninth satellites of Jupiter. Since the orbit of Neptune is so nearly circular, this further implies that the mass of the smaller body must be less than we had previously assumed, both in our original publication, and on the basis of the larger orbit. Nevertheless since it undoubtedly does possess a very considerable mass, analogous as we shall presently see to that of the Earth, and passes quite near to Uranus, less than 5 units, it will in consequence present to the computers the very interesting mathematical problem known as that of four bodies, and this should in time give our descend-

ants a very accurate idea of its mass.

The longitude of its perihelion that I have adopted is 252°.1, its date 1809.0, and the eccentricity 0.195. The other data are given in Table V, which is arranged precisely like Table IV, except with regard to the fourth column. Instead of giving the uncorrected longitudes, which seemed in this case unnecessary, we give instead the varying distance of *O* from the Sun. This changes somewhat the corrections given in the sixth column, especially that for Uranus, which was then much nearer to *O*. The deviations given in the ninth and tenth columns of Table V average less than three quarters as great as those similarly given in Table IV for a circular orbit. Figure 10 showing the computed longitudes on the elliptical orbit of the planet is arranged like Figure 7, and needs no further description.

TABLE V.

LONGITUDES OF *O*. ELLIPTICAL ORBIT.

Planet	Date	Dist.	Dist. *O*	Long. (1900)	Corr.	*O* Obs.	*O* Com.	O — C	Years
Uranus	1841.7	20.1	30.3	353°.7	— 7°.8	345°.9	345°.9	0°.0	0.00
Saturn	1850.8	9.4	32.2	18.7	—16.0	2.7	5.1	—2.4	—0.20
Saturn	1885.0	9.0	36.1	81.7	—17.0	64.7	62.5	+2.2	+0.18
Neptune	1904.2	29.9	35.2	95.0	— 3.5	91.5	91.5	0.0	0.00
Saturn	1917.0	9.1	34.2	117.0	—16.6	100.4	111.9	—11.5	—0.94

We must point out here that this object is in no sense a satellite of Neptune, revolving about it in a period of 165 years, but a true primary planet. Were it a satellite, controlled by Neptune, such a period would require that its distance from that planet should be only 1.116 units, whereas in point of fact it is at five times this distance. It is obviously premature at present to consider any perturbations that Neptune would introduce in its orbit. It must be mentioned further that, even if this orbit is approximately correct, we have no proof that the period is exactly the same as that of Neptune. Indeed the investigations of Lagrange would seem to imply that this is impossible. In case its period differs slightly, and it only happens to be near that planet at the present time, conjunctions must be extremely rare, certainly hundreds, possibly even thousands of years apart. In either case, however, there are one or two curious, although elementary facts, that would ensue. One is that although its motion is direct about the Sun, yet to an assumed inhabitant of Neptune it would appear to move in a retrograde orbit, like Neptune's own satellite. Another fact is that it would appear full in only one of the constellations, and not until after a long period, if at all, in any other. Again it would appear full for only a comparatively short time once in 165 of our years.

It is an instructive circumstance that the computed heliocentric longitude of *O* in 1928.0 based on the elliptical orbit is 131°.4, or distant only 1°.0 from its position based on the wholly different circular orbit. In 1934 as in 1904, the two longitudes will coincide. The reason

for this is evident on comparing Figures 7 and 10. The present distance of *O* on the two orbits differs by about three units. This illustrates, in a way, how much easier it is to predict a position in the sky by gravitational means than it is to predict an orbit. It further shows how great an effect on an orbit, and how little an effect on the position in the sky, is caused by a very slight change in the assumed location of a maximum in the orbit of Saturn. Also it shows how important with regard to the orbit, a more accurate location of Saturn might have been, had it been possible to secure one in the years 1917 and 1918.

With regard to the latitude of *O*, that appears to be a pretty difficult problem to solve merely by gravitational methods. It did not require solution in the case of Neptune, but it is doubtful if the measures of Uranus in declination at that time were of sufficient accuracy to have been of any use, had the problem been attempted (See Figure 28 of my original publication). At all events no one as far as I know has ever attempted its solution, and it is very doubtful if the accuracy even of our present day observations is sufficient to render a useful solution obtainable. This is merely because the deviations are so small in proportion to the very small errors that accompany them. It appears according to Greenwich that from ever since 1904 up to the present time Neptune has averaged 0″.3 to the south of its computed position. There seems to have been a deviation reaching a maximum of about 1″ in 1918, although this may have been due to accidental errors. In 1918 Neptune was in longitude 125°, and assuming the same difference between the longitudes of the maximum force and the maximum effect as we found earlier for Neptune and Uranus, namely 35°, we should have the maximum southern position in longitude 90°, and the ascending node in longitude 180°.

If we call the maximum deviation only one-half the observed value, or 0″.5, we shall be on the safe side. This compares with the deviation 2″.7 in longitude (Figure 5) and would imply a deviation in latitude as seen from Neptune of 10° toward the south. As seen from the Earth this would amount to only 1°.4. It therefore appears, since *O* is nearly enough in the same latitude as Neptune, to affect it in the same manner as Neptune did Uranus, that we are not obliged to look very far from the ecliptic in any case, in order to find it.

TABLE VI.

PERTURBATIONS.

Known	Neptune				*O*				
Planets	Outer	Inner	Diff.	Dev.	Outer	Inner	Diff.	Dev.	Ratio
Uranus	30.2	19.7	10.5	88″	30.3	20.1	10.2	2″.7	33
Saturn	30.0	9.6	20.4	24	32.2	9.4	22.8	0.58	41

With regard to the mass of *O*, the case is quite simple, since we can compare it directly with that of Neptune. In Table VI the headings give the names of the two perturbing planets, and the first column the

names of the two that are perturbed. The next four columns give the distances of the outer and inner planets, the difference between them, and the amount of the maximum perturbation. The four columns following are similar. The two perturbations of Uranus are taken from Figures 3 and 5, that of Saturn by Neptune from Figure 19 of my original publication, while that of Saturn by *O* is the mean of the three perturbations given above. The last column gives the ratios of the perturbations caused by the two disturbing planets. Since the distances of Neptune and *O* in the first line are similar, also the two distances of Uranus, and the two resulting differences, the final ratio may be taken as giving the relative masses of Neptune and *O*. The same is true of the second line. The mass of Neptune is 17.16 times that of the Earth; therefore expressed in terms of the latter body, the mass of *O* as determined from Uranus is 0.52, and as determined from Saturn 0.42. These results are surprisingly alike, and would be still more so if we applied a correction for the slight differences of the distances given in the table, which would diminish slightly the masses determined from Uranus, and increase that as determined from Saturn. Nevertheless, little weight is given to the latter result, which serves mainly as a check on the former, and also as indicating that the three perturbations which we have identified for Saturn were of the intensity which should properly have been expected. As a result of this investigation we conclude that the mass of *O* is practically 0.5 that of the Earth. This would make it two-thirds that of Venus, and rather more than four times that of Mars.

In order to determine its size and brightness, we shall assume its density and albedo to be the same as that of the Earth. This we consider to be more likely, on account of its small size, than that in these respects it should resemble Neptune. In case it really does resemble the latter planet, however, both its size and brightness will be slightly increased. Making these assumptions its diameter proves to be 6300 miles, and its angular diameter 0″.5. This last figure is about half that of the first and second satellites of Jupiter. This fact, taken in connection with its faintness, renders its recognition as a disk impossible. Its brightness varies inversely as the fourth power of its distance, and, assuming the magnitude of the Earth as seen from the Sun to be —3.5, gives us a resulting magnitude of 12.1.

The following ephemeris has been computed: 1928, Feb. 1, $8^h\ 56^m$; Mar. 1, $8^h\ 53^m$; Apr. 1, $8^h\ 51^m$. If we assume that the planet is located 1° south of the ecliptic, its declination will be +16°.5. In closing I wish to express my thanks to Professor Shapley for permitting one of his assistants to furnish me with much of the more recent planetary data.

Appendix.

In case the planet should not be found in the immediate vicinity of the location indicated above, it will be of interest to consider the size of

the error that may be expected. Leverrier's error in locating Neptune was but 52′ in heliocentric longitude,—a very remarkable result. Adams' error was 2° 27′. Both astronomers assumed that the planet was located near the ecliptic,—and such proved to be the case. Since the location of *O* given above depends on the perturbation of three known planets instead of one, and since four of the five determined points agree satisfactorily with either of the two orbits, and the other point is not far distant, it would seem as if the heliocentric longitude of the computed planet should not deviate from that of the real one much more than did those of Leverrier and Adams from Neptune. It should be noted moreover that the important point is to find the planet, the orbit is of comparatively little consequence, except as enabling us to locate the planet's present position in the sky. That found, the orbit can then readily be determined with accuracy.

Finally it should be pointed out that our most certain indication of the existence of the planet, and also our most accurate guide to its present location, is its perturbation of Neptune. Its sharpest point of inflection was already passed some twenty years ago, and every year since then its true position is likely to deviate more and more from any that may be computed. No time should therefore be lost in locating it. The next perturbation that can be used will be one of Saturn about 1950. This will be of little consequence, however, since it will be very small. The next important one will be one of Uranus at the beginning of the next century. We cannot tell when the next perturbation of Neptune will occur, but we do know now that it will not be until long after that of Uranus.

PRIVATE OBSERVATORY, MANDEVILLE, JAMAICA, B.W.I., January 25. 1928.

THE OCCULTATION OF SIGMA SAGITTARII, 1928, APRIL 12.

By WILLIAM C. DOYLE.

Of the 1928 series of occultations of σ Sagittarii only two will be visible in the United States: the first on April 12 (last quarter of the moon), and the other on July 2 (full moon). The accompanying maps (drawn according to the graphical method of the late Father Rigge) give us the times of immersion and emersion of the April occultation for the United States. By Figure 1 we see that the immersion will be observable in the entire eastern part of the country and in the central part as far west as the black line marked "At Moonrise." On this line it will occur exactly at moonrise. The full line curves marked with a large 2, 10, 20, 30, etc. give the Central Times for the places at which the immersion will occur at 2:00 o'clock A.M. and at ten minute intervals

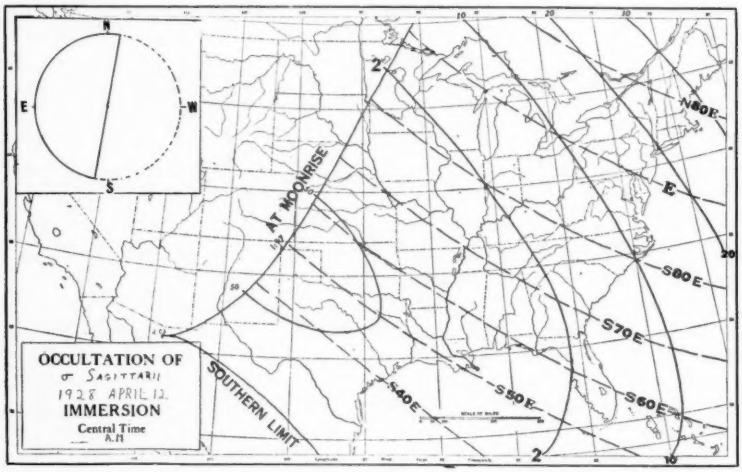


FIGURE 1.

before and after. By measurement of tenths of their distances apart, single minutes of time may be found for intervening places.

The emersion will be visible in both the eastern and central United States and as far west as the black line, where it will occur at moonrise. As above the full line curves marked 3, 10, 20, etc. give the time of emersion for the different parts of the country. The closeness of the curves and the inaccuracy of the graphical method rendered it inadvis-

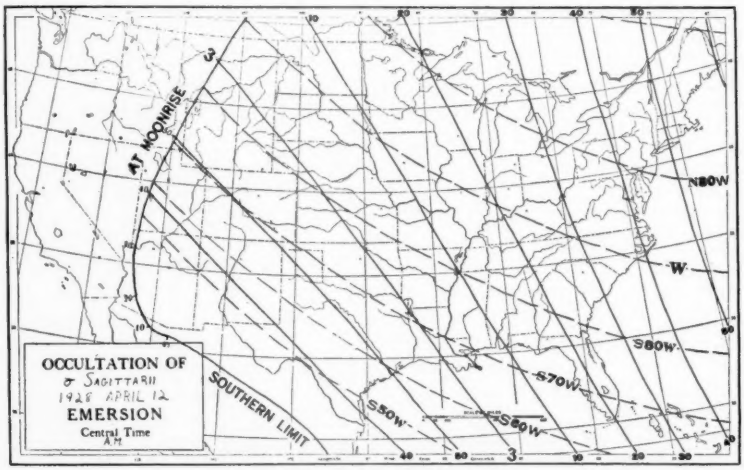


FIGURE 2.

able to draw the time curves for the extreme southwest, but it will vary from 2:03 o'clock A.M. at the spot marked to the first curve at 2:40.

The broken lines from S40E to N80E and from S50W to N80W give the number of degrees east or west of north or south at which the star will appear or disappear. The inserted diagram of the moon shows that the north point is ten degrees and forty minutes east of the upper end of the terminator. The position angles may easily be measured from this point.

The occultation will occur about 24 hours before the last quarter, with the moon a little more than 90 degrees west of the sun. σ Sagittarii is of 2.1 magnitude.

THE ASTRONOMICAL FRATERNITY OF THE WORLD.

By DAVID B. PICKERING.

PART V.

Marseilles is the western terminal of the French Riviera, whose chief artery, the great Corniche road, extends thence eastward through many charming shore resorts until, over one hundred miles away, it strikes a cleft in the Alpine foot-hills and continues on into Italy. Arc after arc of blue bay breaks the shore-line into scalloped undulations through its entire length. Most charming of all the towns through which it passes is Cannes which nestles in the arms of its little bay only thirty miles from the Italian border. Here for the winter season come the fortunate children of earth, and here we decided to sojourn. Where else could one so easily cast off the cares of the world as along the Croisette, that palm-shaded promenade which curves for over a mile between the broad avenue and the beach? Here all the world comes of a morning, attired, you may be sure, in its most gorgeous plumage, and, strolling languidly or lounging in great wicker chairs, basks in the brilliant flood of sunlight that pours over sea and shore. Over the water the white gulls sweep. Along the walk, amid the throngs, the ubiquitous commercial photographers and the picturesque, dark-skinned sellers of worthless but colorful rugs ply their boresome trades. Between the gulls and the gullibles slopes the broad pebbly beach dotted with groups of children. Nearby, stands the gorgeous Casino, where one may rejoice in such a luncheon of French delicacies as is never to be forgotten. The jovial Prince of Wales, who afterward became Edward the Seventh, loved Cannes, and the statue of the king attired as a yachtsman, stands on the Croisette near the Casino. Just beyond and into the bay, stretches the long stone Albert Edward jetty, to which are moored scores of private yachts, from whose taffrails fly the flags of all the world. Some of these belong to the crowned heads of other

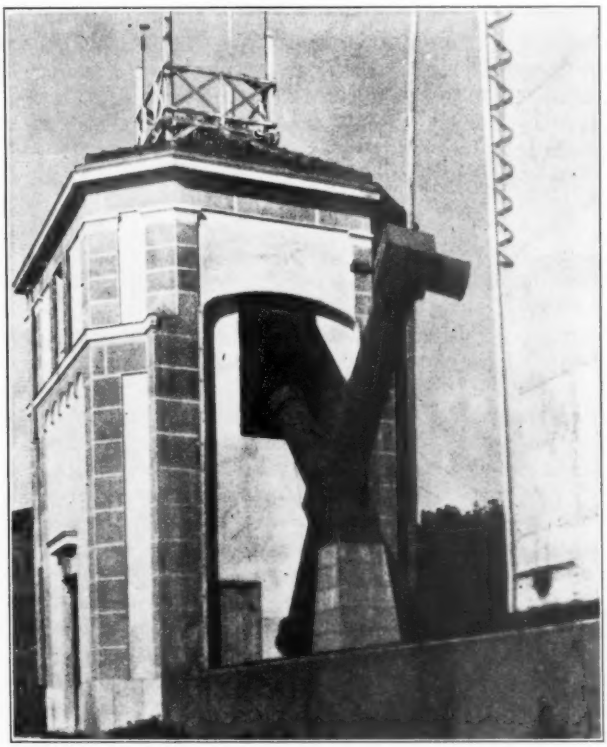
nations and perhaps, on a Tuesday or Saturday Gala-night in the Casino, one may sit at the next table to the King and Queen of Sweden, or rub elbows about the gaming tables with a profligate princeling who is busy scattering his wild oats about the world, before returning to the gilded palace of his ancestors.

Nice, largest and most famous of Riviera resorts, but seemingly far less delightful than Cannes, is reached by comfortable buses in about an hour. Thence, on a clear, sweet morning, I journeyed to visit the observatory that perches high above the city on the summit of Mt. Gros. The great roadway branches at Nice where one arm leaves the shore and winds up and up to the crest of the hills where it passes the entrance to the observatory grounds. This is called the Grand Corniche and, because of the extended views it affords, is a favorite with the tourist. It continues on its elevated course until, some miles farther, it reaches the little village of La Turbie from which one looks down upon the miniature principality of Monaco and sees the famous Casino of Monte Carlo sixteen hundred feet below. A bus line runs regularly over this route, but I chose to make the ascent by taxi. As the car proceeded to climb above the city and the sea, the graceful white dome of the observatory was nearly always in sight; even after entering the grounds the roadway continued to wind upward, skirting the edge of the mountain. From this point one could trace the sinuous course of the Paillon which, except in flood time, is little more than a shallow brook, filling but a fraction of the wide, white-pebbled bed of the river, like a white serpent escaping from the sea to hide between the higher hills of the north.

The good woman at the lodge gate informed us as we entered that the director, Dr. Fayet, had gone to Paris and that no other member of the staff was about. However, she gave us the freedom of the place and we proceeded to climb for another half mile or so to the side of the great dome, where we parked our car, anticipating a certain thrill in the solitary, external investigation of the place. It appeared to be much higher above the sea than the twelve hundred feet of its actual altitude for the hills are steep and from beside the dome one looks down in three directions, and all is beautiful.

The Observatory of Nice was built and endowed by Raphael L. Bischoffsheim, 1881-87. At that time the great 30-inch refractor by Henry and Gautier was the largest in Europe and is now surpassed only by that of Potsdam, Germany. What an exquisite thing is its white dome, resting upon its marble base of Egyptian architecture, in this perfect environment! The main entrance doors are surmounted by a bronze bust of Science whose hands, bearing torches of Enlightenment, reach far out above the portal. The dome itself, floating in a bath of chloride of magnesium, is eighty feet in diameter and weighs ninety-five tons. From here to the eastward, a broad paved roadway extends through the foliage for perhaps three hundred yards to the graceful

dome of a 15-inch refractor, and above the low, stone retaining walls of this road cluster giant cacti and clinging vines. Set amid the palms along its length are half a dozen smaller buildings, one of which is obviously used for telegraphic and wireless purposes. A large water tank stands between two transit houses and beyond, just short of the last dome, stands the 15¾-inch Coudé of Gautier.



Equatorial Coudé of the Observatory at Nice.

Most of these buildings, being upon a low terrace, are reached by stone steps that break through the retaining wall and connect with paths that lead beneath the palms to their various entrances. On a lower terrace, facing the south and the sea, nestles the residence of the director; a low, white, bungalow-type building of three sections connected by pergolas, the roof line being well below the higher level. I have yet to visit Mt. Wilson, but those, who know, claim that there is a suggestion of similarity between the situations of the two.

It was dusk when I again alighted at Cannes, chilled to the bone by

the dread mistral, which each afternoon blows across the water out of the southwest with clock-like regularity. Though the sun may be bright and the sky cloudless, yet the beach and the Croisette are soon vacated and it is difficult to believe that only a bit earlier the thermometer told of 70 degrees and the populace sat basking in the sun.

Somewhat later, we traveled, overnight, into Switzerland; not an easy task, for, since the railroads on this route use no sleeping-cars, one must negotiate a compromise affair that necessitates crawling, still dressed, into a bag and reclining upon an extended seat. Blankets and pillows are rented from a woman on the platform before leaving and are dragged aboard the train with the luggage.

It was a relief, upon arriving in Geneva, to find the good-looking observatory in the heart of the upper city, a busier place than the deserted institution which I had so recently visited. We regretted to learn, however, that no astronomical work, other than the determination of time, was now being carried on. The Geneva Observatory was founded in 1773, but the present buildings were erected in 1830 and since 1861 the institution has been the center of important Swiss geodetic operations.

The director, Dr. Raoul Gauthier, was not in when we called, but Dr. Rod, a most affable gentleman, acted as our guide and advisor. It is he who conducts the chief activity of the institution, which is rating of watches for the trade of Geneva. In this city or its neighboring towns, are made the world's finest time-pieces and, sad to say, many of its poorest. For commercial purposes the manufacturer cherishes certificates from the observatory vouching for the close rating of his product. The white-smocked Dr. Rod showed us several constant-temperature vaults wherein were tray upon tray of tagged and ticking time-pieces whose records were being strictly kept by one Mlle. Blaser in her business-like office. This part of the institution abounded in very efficient instruments for wireless reception and for the determination of meteorological conditions. We later inspected the 39-inch mirror whose entire house revolves about the central pier upon a track in the flooring.

There is also an 11-inch Mertz refractor which was acquired in 1880 as a gift from the director of that time, Dr. E. Plantamour. There was considerable spectroscopic and photographic material connected with both these instruments, but all gave evidence of a long period of inactivity. It was regrettable to find such things idle at this time, when all the world seems bent on furnishing data for astronomical research, but we were assured that Dr. Paul Rossier, of the observatory staff, contemplated an observational program in which these good aids would be well employed.

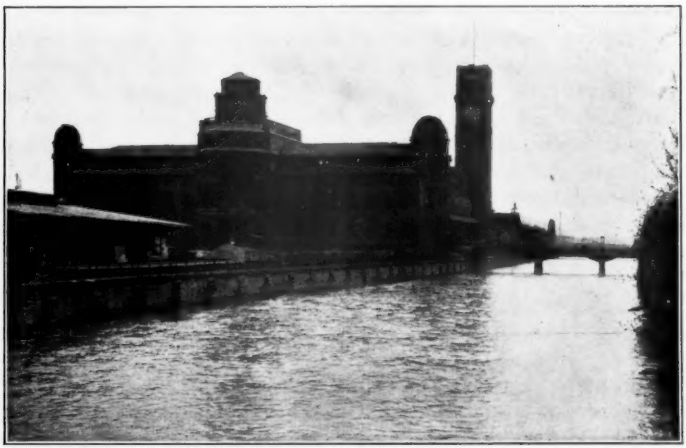
I have more than once spoken of the thrill one feels upon making an initial entry into a new land, among strange people. Because of all we had learned of the thrift and enterprise of the men and women of

Germany and of the brilliant achievements of her scientists, we were keyed up to a high pitch of expectancy as we crossed lake Constance from Romanshorn to Lindau in Bavaria, on our way to Munich. The spotless cleanliness of the little steamer; the orderliness and neatness of the towns and farm-lands through which we passed, and the purposeful, business-like activity of the people we observed, all checked with the reports.

For me, Munich contained two objectives: The Deutsches Museum and the Bavarian Observatory. As one progresses eastward through any of the main arteries of the city he comes perforce to the river Isar, where it indeed "rolls rapidly," from south to north. As one stands across its flood on one of the many bridges that span it and looks southward toward its source, there appears in the field of vision the massive structure of the Deutsches Museum—that part of it at least, which is so far completed, for nearby are heaps of raw material—bricks and sand and temporary housings—all significant of further construction. It stands alone on an island in the narrow river southeast of the old city. Three astronomical domes are aligned along the roof at one end, the largest and middle one, containing the great Zeiss Planetarium. High on a square tower there appears a clock-like face, twenty feet in diameter. This is an aneroid barometer and can be read at a great distance.

The Deutsches Museum of the Masterpieces of Natural and Technical Science, to give it its full title, is the result of the genius of Dr. Oskar van Miller. This gentleman, with his co-workers, had labored twenty-five years to bring this project to the state where it could be opened to the public in 1925. Surely nowhere in the world is such another. Not in one article or one book could it be adequately described. Suffice it to say that though only partially completed, there are now nine miles of exhibits. The perfect arrangement of these makes it impossible for one to miss or repeat, for the time being, any feature. So splendidly is it all planned, that the visitor seems to float along his directed course quite unconscious of the fact that other crowds are somewhere moving in opposing directions. The chief attraction, however, seems to lie in the fact that the exhibits for each branch of science, industry, or commerce are, wherever possible, the originals, whether ancient or modern, or exact replicas of these, both in size and material. All are so placed that one acquires a most comprehensive and enlightening knowledge of the evolution of the subject that may have his attention. Best of all, by the use of levers or cranks, wind or compressed air, every device or piece of machinery may be put in operation and demonstrated, not by an attendant, but by the visitor himself and at his own sweet will. Here are actual and complete locomotives; the original U-Boat; Lilienthal's aeroplane, as well as original apparatus used by such men as Ampere, Ohm, Hertz, and Roentgen. Here are replicas of the laboratories of famous chemists with original instru-

ments and chemicals. And in the basement, two stories deep and forming the largest exhibit of all, is reproduced a coal mine whose every feature is of original size and character. On one floor in a great bay window facing the north, stand many portable telescopes representing many makers from Fraunhofer to Zeiss, which visitors may freely use to view the city. There is a Memorial Hall where, in painting and sculpture, one may meet the Great of science. There are central



MUSEUM OF NATURAL AND TECHNICAL SCIENCES, AT MUNICH.

restaurants where good food and good service may be obtained at moderate prices. Elevators, ample in number and capacity, connect all floors, and thus one may reach the uppermost and visit the great Zeiss Planetarium. This was the first of its kind. Many others of greater dimensions are now operating in Germany. One enters the dark thirty-five foot dome and immediately feels the illusion of standing in the open, beneath the night sky. The compact and complicated mechanism, which projects the light of the artificial stars and planets upon the concave dome, stands within a central railed enclosure, about which the visitors stand or walk. About fifty persons may be accommodated at once to watch the accelerated movements of the members of the solar system and the seasonal changes of the stars while listening to the explanatory lecture given by one of the two young astronomers employed for this purpose. One with some knowledge of the science is warmly received and taken into the inner court where the more technical details of the mechanism are shown and explained.

America, for the good of its soul, may some day have a great science museum. It is to be hoped that it may equal the Deutsches Museum. Beyond this imagination balks.

Leaving the Museum and walking for nearly two miles to the north through the beautiful wooded park that forms the easterly bank of the Isar, one comes to that section of the city called Bogenhausen. There on the Sternwarte Strasse is the modest entrance to the once Royal Observatory. This is now known as the Observatory of Munich, or the Bavarian State Observatory. The residence of Director Wilkins stands but a few feet back of the open palings of the wooden fence. Owing to the fullness of the shrubbery and the lack of central elevation, one does not sense the proximity of an observatory, so hemmed in is it all by the neighboring residences.

Once inside, we were directed to a group of low buildings of brick, wherein we found Dr. E. Grossman, the first German astronomer whom we had had the pleasure of meeting, and in whose solid build and slow, pleasant manner we marked a great contrast to the temperamental Latin. We have known people whom we could characterize only as *long*—long of face and long of body. Others whom we thought of as *angular*. But Dr. Grossman was *cubical*, square of body and face. He smiled little with his mouth, but his small, keen, intelligent eyes were *always* smiling. Yes, here again, as ever, was the humor which characterized all the astronomers whom we had met.

But here was also a touch of bitterness—just a touch, evidenced when speaking of the equipment and facilities of American observatories as compared with European.

A note of disappointment was perceptible in his voice when he told me that owing to the consistently miserable weather he could observe but from eighty to one hundred nights in the year. "Hier hat Man acht Monaten Winter und kein Sommer" he declared. We found later, that all Teutonic astronomers seem obsessed with the idea that Germany, of all the world, has the poorest seeing conditions—more clouds and worse weather.

As we began a tour of the buildings I was introduced to Dr. Hess, whom we found in the transit house standing near the splendid 6-inch Repsold circle. This very pleasant though nervous young gentleman, with big round eyes set in a slender, ascetic face, was in strong contrast, both physically and temperamentally, to his elder co-worker. They were quite alike, however, in the quality of their cordiality, which was both interested and sincere. There was a touch of pride as well as sadness in their manner as they showed me their largest instrument—an 11-inch Fraunhofer refractor, which had been in service here for over ninety years. The institution was founded in 1809, and after 1840 zone observations were made of some 80,000 telescopic stars with a circle by Reichenbach which was installed in 1824. Their pride, however, is centered in the 6-inch transit instrument and most of their work is now being done with this in making determinations of time and position. Dr. Grossman has ingeniously devised three bars across the objective which elongate the stellar images into thin lines of light. The

11-inch has been used for the observation of double stars and very occasionally for variables, though no systematic work is being done on the latter. Very proud are they also of their fine sidereal clock by Riefler of Munich which stands in its even temperature chamber and is electrically wound. There are two more of these by the same maker, one of which records mean solar time.

Dr. Grossman was formerly at Kiel, though it is now twenty years since he joined the staff of the Munich observatory. Back in his busy office he presented me with a copy of their latest published Annals, dealing with parallax and position. As Dr. Grossman walked with me along the winding paths to the entrance gate, he bespoke his admiration for his fellow scientists in America, and I am sure appreciated the felicitations which our mutual friends had asked me to extend to him. He particularly wished to be warmly remembered to Dr. Shapley of Harvard, whom he knew and admired.

It was a long walk back to the Vier Jahreszeiten, our hotel on the Maximilianstrasse, but all along the shaded paths by the side of the turgid, turbulent Isar, it was very wholesome and satisfying to contemplate the "common touch" with Nature to be felt always in the company of these seekers in space.

Our next step eastward brought us to the shores of the "Beautiful Blue Danube"—so-called; to Vienna, the home of the waltz, the breakfast roll, the Hapsburg dynasty and flagrant, flaunting socialism. It was still a bit too early in the season to find the colorful crowds seated at the sidewalk cafes, but we mingled with the groups that gathered in the numerous charming parks. The Stadtpark particularly attracted us, where the marble-arched, bronze statue of Johann Strauss was always the center of hosts of happy children. Though the city offers much for the recreation of its people, they are not, nevertheless, allowed to abuse their gifts. Parks and streets are noticeably free from litter and, with true Teutonic exactitude, the public are taught the limits of their privileges. No tree can be removed in all the land except with governmental authority and then only if another is planted to take its place. It might seem that the grass itself was held almost as dear, for as I placed my tripod upon it, one day, the better to obtain a vantage point for photographing a charming statue of Schumann, a very typical, militaristic police officer handed me a receipt for two shillings (30 cents) for the fine he was imposting upon me for my offence. I felt much like this amount as I removed the offending camera from the desired spot, without, alas, having obtained the picture. The avenues that circle the older portion of the city are, like the Boulevards of Paris, built upon the sites of the old fortifications and are appropriately called the "Ring."

One section of this highway that skirts the shore of the Danube is called Franz Joseph Quay, and here stands an imposing, dome-topped structure of gray stone. This is Urania, the scientific school of the

people. This unique institution was founded in 1910 for the free dissemination of scientific knowledge among the populace of Vienna. Its several floors are divided into lecture rooms and demonstrating laboratories, presided over by an adequate teaching force and no one craving enlightenment need remain unsatisfied. I had made an appointment by phone with Dr. Klumat, who had charge of the astronomical activities of the institution. Upon my arrival high above the ground, this pleasant and very earnest young man greeted me in a large, well-

URANIA, A SCHOOL OF SCIENCE FOR THE PEOPLE OF VIENNA.

lighted room, equipped with time instruments, and proceeded to explain their methods. After receiving the time signals from Paris by wireless, which is done twice daily to check their regulators, he conducted me to the dome that surmounts the structure and showed me the 8-inch Zeiss refractor with its three oculars set in a revolving adapter. This fine instrument, despite the fact that it was subject to vibration from street traffic, was well suited to its purpose of elemental demonstration. Here were also several portable glasses of two, three, and five inches aperture for the use of students. From the dome, Dr. Klumat showed

me the place upon the roof where during the war, a small cannon had been stationed and discharged automatically each day at noon by clock device.

It was a long tram ride from Urania to Turkenschantz Park, near which is the Observatory of the University of Vienna. On the way one passes miles of modern edifices comprising the newer part of the city, and, ever climbing gradually higher to the northwestward, reaches at last the clean, attractive pleasure resort, a square or two from which is the entrance to the observatory grounds. These were surrounded by a stone wall, but the interior, despite its far denser verdure, reminded me somewhat of the situation of the Harvard Observatory. It was midday, clear and warm, and in this residential neighborhood the streets were almost deserted, but I saw two little boys enter the grounds, between the tall brick portals, each carrying two hugh steins of foaming beer, perhaps to the thirsty computors. This was something I had never as yet observed at Harvard. I followed them in and fortunately so, for otherwise I would have had difficulty in selecting the correct path from amid the maze that wound through the trees. So dense was the foliage that buildings and domes were quite concealed. At last, however, my unconscious guides led me to the entrance of the great, red-turreted, brick building, whose massive, surmounting dome just topped the clustered trees about it.

A wide porte-cochère protected the great doors, through which I passed into a large marble vestibule. Immediately beyond, rose a wide flight of stairs whose well was entirely open to admit a flood of light from the glass roof above it.

From the stair-top, a hallway ran entirely around the well, faced with doors which opened into offices and computing rooms. The strong, diffused lighting and the architectural effect of the interior gave the feeling of entering a museum or an art gallery—all was so impressive and dignified. My guides and their sparkling burden had disappeared and I paused to look about. In the marble wall of the vestibule at my left was a bronze tablet with a bas-relief portrait inscribed to Edmond Weiss, the first director of the present observatory, from 1848 to 1908, who had died in 1916. Over the inside of the vestibule, facing the stairs, was a bust of Franz Joseph. There now appeared, at the head of the stairs, a short, blonde gentleman in a black smock, whose round dimpled face smiled down upon me. This was Dr. Hans Krumpholz, who greeted me with great cordiality and immediately went in search of the director, Professor Heppenger. Because of the very serious illness of his wife, who was in a sanitarium nearby, the director was much away and we learned that he was now absent, but would return later in the afternoon.

We thereupon entered an office, where Dr. Krumpholz introduced me to a man with whom I became strongly impressed and whom I still hold in the highest regard. This was Dr. W. A. Bernheimer. Standing in

his black smock, his thick, black hair a bit touselled, his dark, kindly, thoughtful eyes seeming to penetrate into your very mind, he appeared to be the true personification of Science. I later learned that he had been one of "Max Wolf's boys" after his graduation from Heidelberg, and still later heard from Professor Wolf himself in what high esteem he was held by the latter. Both of these young men, who, I feel sure, must still be in their thirties, now waved aside my earnest protest against their entertaining me at a time when I felt that they should be enjoying their mid-day repasts, for I cannot but believe that astrono-

Dome of 27-inch Refractor, at Vienna.

mers are human to this degree, and insisted upon conducting me at once through the institution and explaining its history and accomplishments.

The Imperial and Royal Observatory of Vienna was founded in 1756 and was first established upon the University building, situated on the Ring, in the lower city. With the poor instruments of that early day and with unsuitable location and surroundings, little, if any, observational work of value was done. In 1826, better instruments were acquired, and in 1832, came a 6-inch refractor by Fraunhofer and a 4-inch meridian circle. These were then used for observing planets and comets.

The present observatory, with its four domes, was constructed during the years from 1874 to 1879, at which time was added an 11¾-inch

Clark refractor. In 1882 came the 27-inch refractor by Grubb and still later, the Gautier equatorial Coudé, of 15 inches. There is also a 13-inch photographic refractor by Repsold.

Just beyond the head of the main stairway is the cylindrical enclosure of the base of the large refractor. Here the circular wall is hung with photographs of other institutions, conspicuous among which are the familiar views of both the Cambridge and Arequipa stations of the Harvard Observatory as well as those of Yerkes, Lick, and Mt. Wilson. The concrete bases of both the Grubb and Clark glasses were the most massive I had yet seen, resembling huge pyramided blocks about which spiraled the open iron stairways ascending to the observing floors at their summits.

The 27-inch glass, whose dome is 45 feet in diameter, was being used, with a photometer at this time, by Dr. Bernheimer for the observation of variable stars and the planets, while Dr. Krumpholz employed the Clark glass upon double stars. Dr. Rheden operates the 13-inch photo-visual telescope, and has constructed many new clock devices for driving it. The latest of these was attached to the instrument and the claim was made that it would follow perfectly for a period of thirty minutes. The staff were all enthusiastic about it and felt that it might prove, after fuller tests, a most valuable invention. The 15-inch Coudé has its own building, turreted like the other, but some distance away. Here a fine new spectroscope was arranged to be ingeniously attached by means of a set of overhead rail-carriers. Dr. Hnatek uses the Coudé, largely for determining the radial velocities of the stars. Another separate building contains a 6-inch refractor, while several smaller portable glasses are on hand for the use of students and visitors. All accessory departments, such as studio, dark-room, enlarging room, supply room, etc., seemed exceptionally well arranged and equipped. The library was especially fascinating.

Well I know the pride that Dr. Bernheimer felt, as in a snug corner of this book-crowded room, he treated me to a sight of some of the rarest first editions of scientific literature. Among these were works by Bode and Bayer, and a Talman's Almaghast* of 1551. But most interesting of all was a work in Latin, inscribed Simone Papiensem-dietum Beuilaquam (Simon Biuilaqua) and dated 1498-1517, having been printed in Venice during that period. On the fly-leaf was written, in ink, "Vienna University, 1680"; the date when that institution had acquired it. Here were found bound volumes of all the numbers of Popular Astronomy since its beginning, as well as those of the *H.C.O. Circulars and Bulletins*. In the well arranged clock and wireless rooms, we listened to signals from Paris and Bordeaux, and Dr. Bernheimer told me that their clocks, as compared with these stations, check

*Probably a copy of the edition of the works of Ptolemy published at Bâle in 1551 (Ball, "A Short History of Mathematics," 1915, p. 96).

to a daily average of 0.1 second. Here were also the two-tube sets upon which they receive short-wave signals from America. The observatory is required to furnish correct time to the railroads and the fire department, daily at 10:00 A.M. and at noon, and this was then being done by hand key. No doubt that by this time, there is in operation the large clock device, which was then being tested, which performs this service automatically.

Dr. Harlow Shapley seems to have acquired abroad a reputation for his keen interest in all things *new*, and because of this, Dr. Bernheimer asked me particularly to call his attention to a clock which had recently been built by a local manufacturer. This was made with a cylindrical quartz pendulum, perhaps ¾ inch in thickness and 2½ feet long, which because of its very low coefficient of expansion, was expected to insure very close rating. After tests covering many months, Dr. Bernheimer was assured of its excellent behavior. For weeks at a time the variation would not exceed a few hundredths of a second.

I was, of course, interested in hearing of Dr. Palisa, who died in 1925, and whose famous investigation of the asteroids covered the period of his service upon the staff of this observatory. I was told that he had discovered 123 of these little worlds.

Here again I was to hear of poor seeing conditions, for Dr. Bernheimer explained that because of the city lights, one could not distinguish, visually, stars below the 12th magnitude, even with their largest glass. He said that they had great trouble in making spectrograms of even the 6th magnitude stars. He spoke, however, of the fine results they had obtained in studying novae Cygni III and Aquilae III.

Here I learned for the first time, of the very modern equipment that is being installed in the Observatory of Hamburg, which is expected to make it the best-fitted and most modern institution of its kind in Europe; of the large planetarium which was soon to be erected in Vienna, and which is now probably in operation; and of the new "Hand Book of Astro-physics" which was soon to be published in Berlin. This is being edited by Professor Ludendorf of Potsdam and Professor Kohlshutter of Bonn and will be printed in six volumes. Dr. Bernheimer has contributed to this, as well as Drs. Shapley, Mitchell, and Abetti, among others.

Dr. Bernheimer had had the pleasure of meeting Dr. Annie J. Cannon in Copenhagen and had long been familiar with the work of Mr. Leon Campbell in the field of variable stars. Even so slight an acquaintance with these "Home friends" gave us a closer bond of interest.

It was mid-afternoon before I was conducted to the study of Professor Heppenger, who had just returned to the observatory. Seldom have I been in the presence of a more imposing figure. Tall and straight he was, of a military bearing which the advancing years had not affected, and the gray beard and hair, softened his kindly intelligent features.

He greeted me with that same wholesome warmth and courtesy which I had come to believe was an invariable attribute to the manners of these cultured people. He seemed very desirous of having me tell him what I could of his friends in America and inquired as to how Professor W. W. Campbell was progressing with his dual responsibilities, spoke of Professor Frost's facility with the German tongue, and recalled the Harvard Observatory in the days of Mrs. Fleming. He was most interested in discussing the development of astronomical stations in South Africa and was glad to learn more regarding that of Harvard near Bloemfontein.

Before he would allow me to depart, he insisted upon ascertaining if everything had been done for my entertainment and information that he would have desired, and begged me to convey his sincere regards to any of his American friends whom I might later meet.

Dr. Bernheimer saw me to the portal. As he grasped my hand and smiled farewell from those dark eyes of his, beneath his tumbled black hair, he little guessed how much of himself he had given this casual visitor from far away.

Passing under the trees, as I again sought the correct path for my exit, I noticed in a natural, shrub-circled arbor a little family group having their afternoon cake and coffee, out in the beautiful spring sunshine. I recognized Dr. Krumpholz, who now appeared very human and rather shy, having doffed the professional black smock, and he introduced me to his charming wife and that plump bit of sturdy, feminine humanity, whose round face shone like a rosy apple—his four year old daughter. I insisted upon taking their picture, and though all were smiling, only the rosy daughter was quite without self-consciousness. The good doctor now guided me through the green maze to the street, well content with the day's adventure, to make my way down again into the city of music and memories.

AMERICAN ASTRONOMICAL SOCIETY.

REPORTS OF OBSERVATORIES 1926-1927

[*Continued from page 114.*]

YERKES OBSERVATORY

UNIVERSITY OF CHICAGO

WILLIAMS BAY, WISCONSIN

Personnel. The resignation of Mr. O. J. Lee, assistant professor of the Observatory, was effective on August 1, 1926.

Mr. Frank C. Jordan of the Allegheny Observatory was research

associate during July and August, and was occupied with stellar photometry.

Mr. George W. Moffitt was appointed research associate and began his work in the department of stellar parallax, as well as solar physics, on September 10.

Mr. W. W. Morgan began as assistant on September 6, 1926, and was assigned to the stellar spectrograph and solar observations with the 12-inch telescope.

Miss Mary R. Calvert was given the rank of assistant from April 1, 1927.

Mr. C. T. Elvey was assistant in stellar spectroscopy during the summer of 1926.

Mr. N. T. Bobrovnikoff was fellow during this year, devoting his time chiefly to the study of our collection of photographs and spectrograms of comets, and obtained new ones.

Mr. Ross left for the Pacific Coast on August 4, taking our planetograph of his design for the purpose of photographing Mars. He was at the Lick Observatory and for longer periods at the Mt. Wilson Observatory where he had opportunities to use the 36-inch refractor and the 60-inch reflector. He returned on October 26. He left again on May 17, 1927, for Mt. Wilson for an extension of the work in photographing Venus and Jupiter in light of different wave-lengths from infra-red to ultra-violet.

The Director was absent from the Observatory from February 12 to April 9, on a vacation trip to the South.

Mr. Struve spent the summer of 1926 at the observatories on the Pacific Coast, chiefly at Mount Wilson, and was engaged in the study of the detached calcium lines [H] and [K] in the stellar spectra.

Equipment. To the Bruce telescope was attached a three-inch doublet lens of 21 inches focus, designed by Mr. Ross, for the use of visual rays, with a yellow filter before the objective, and having exactly the scale of the Ross photographic doublet added last year. These twin cameras are mounted side by side on the tube of the 10-inch doublet.

A fine modern milling machine was purchased for the instrument shop.

For the first time since the Observatory was opened, the structural steel and sheathing on the inside of the great dome and under the rising floor was painted, two coats. This rather large undertaking made it necessary to give up the use of the 40-inch telescope by day for a period of six weeks in the autumn of 1926, but the work at night did not suffer serious interference.

The running of the driving clock of the 40-inch telescope was carefully studied by Mr. Moffitt, and as a result, Mr. Ridell was able to improve still further its excellent performance.

For the protection of the Observatory's interests, three acres of ground, with dwellings, were acquired by the University early in 1927.

Special funds were granted for the re-mounting of the 12-inch telescope, so as to carry both the visual and photographic objectives, each of 12 inches aperture and 18 feet focus. As a preliminary, the shutter of the 26-foot dome was widened from 28 to 56 inches, during the spring, at a cost of $3000. The mounting was shipped to J. W. Fecker, successor to Brashear, at Pittsburgh, on May 20, 1927. By using duralumin for the twin tubes, it will be possible to keep down the weight, so that most of the old polar head can be retained. Plans are made for several new or altered attachments for the telescope. A 5-inch Clark telescope, which had been loaned to the Observatory some years past, was thereafter used for securing the routine photographs of the sun.

Weather Conditions. These were even more unfavorable than in the preceding year, as may be seen from the following record of the nocturnal hours of observation with the 40-inch telescope, to which are added the departures from the normal.

1926	Hours	Dep.	1927	Hours	Dep.
July	98	—43	January	82	—50
August	108	—43	February	114	— 6
September	59	—92	March	124	— 3
October	92	—72	April	78	—40
November	72	—61	May	74	—41
December	72	—53	June	110	—10
				1083	—514

Thus the normal number of hours was approached only in February, March, and June, 1927. As to conditions during the day time, 72 days were entirely clear, 107 were more clear than cloudy, and 186 were prevailingly cloudy. The rainfall during this fiscal year was 42.64 inches, which was 36 per cent more than our normal for the past 25 years.

Solar Work. Owing to the unfavorable weather after the painting in the great dome was completed, the spectroheliograph was not used for routine observations during the year. 16 spectroheliograms were obtained on 6 days. Its optical and mechanical performance was carefully studied by Mr. Moffitt, and improvements were made upon it in the shop. The large Petzval doublets were examined on the optical bench and the source of much of the disturbing stray light was located. The study of the instrument was still in progress at the end of the year. On ten days during June, 68 direct photographs of the sun were made while an interesting group of large spots was passing. Improvements in this solar camera are being studied. With the 12-inch telescope, 259 routine photographs were taken through a filter on 104 days, and thereafter 42 photographs on 19 days with the Clark 5-inch. Visual observations of prominences were made on some favorable occasions. After January 1, 1927, heliographic positions were determined for the spots and groups on days for which these data were requested by

the superintendent of the U. S. Naval Observatory, for publication in the *Monthly Weather Review*. These measures were made by Mr. Morgan.

Observations with the 40-inch Telescope. Micrometric. Mr. Van Biesbroeck made 248 measures of double stars on parts of 31 nights. The printing of Part I of Volume V of our publications, containing his observations of Hussey stars and others, was completed. He obtained visually 74 positions of eight different comets; and made two photographs of comet Pons-Winnecke for determining the cometary refraction. He secured five positions of the satellite of Neptune, 181 estimates of the brightness of variable stars, and observations of three occultations. He took 23 plates with this instrument for determining mass ratios of double stars.

Astrometric. 121 plates were obtained, 4 by Mr. Lee, 11 by Mr. Jordan, and 106 by Mr. Moffitt, on parts of 53 nights. About 30 stars were added to the program, chiefly from a list of giant M stars, for which large spectroscopic parallaxes were determined by Adams, Joy, and Humason, but for which trigonometric parallaxes have not been published. Mr. Moffitt has carefully studied the whole problem of photographic stellar parallaxes and has found it possible, by improved methods of development, to reduce greatly the time of exposure previously needed. This will also make it possible to reach fainter stars with reasonable exposures.

Spectrographic. 373 spectrograms were obtained by Messrs. Barrett, Struve, and Morgan, all of them being taken with the dispersion of one prism. They were chiefly stars of Class A and certain spectroscopic binaries. The orbits of the following were computed during the year:

27 Canis Majoris by Mr. Struve,
36 τ^9 Eridani by Mr. Struve and Mr. C. Hujer,
95 o Leonis by Mr. Struve and Mr. Morgan,
6 π Scorpii by Mr. Struve and Mr. Elvey.

In the autumn Mr. Struve reduced his observations of the detached calcium lines in stellar spectra which he made at the observatories of the Pacific Coast, and his paper was published in *The Astrophysical Journal*. During the last weeks of 1926, a single Mantois prism was used for the study of the detached [D] lines of sodium. For the bright stars, exposures with Ilford Process Panchromatic plates, of from two to three times that required for the violet region gave satisfactory results. During the year, a total of 500 spectrograms was measured by Mr. Struve, chiefly of Class A; 66 by Mr. Hujer; 62 by Mr. Pogo; and 10 by Mr. Morgan. Mr. Elvey continued his work on the spectra of Nova Aquilae of 1918. Mr. Pogo was mainly occupied with the study of the helium star, 96 Herculis, and Mr. Hujer, with the examination of stars having strong silicon and strontium lines. Experiments were continued with the Moffitt lens of 143 mm focus, ratio 1 : 2.8, and it was found that stars of mag. 9.0 could be photographed with it in

two hours.

New plateholders of steel were made for use with this camera because of the necessity of focusing within two or three hundredths of a millimeter. This lens is a very valuable addition to the equipment of the Bruce Spectrograph. Good progress was made with the reduction of the measured plates of A stars, and work was continued on the reduction of the high-dispersion plates of the earlier list of standard stars.

Mr. Frank D. Urie of the Elgin Observatory used the 40-inch telescope on parts of two nights and the whole of a third, in October, 1926, for experiments with a photoelectric cell, with the use of vacuum tube amplification with the current sent to the galvanometer. The results were promising and the experiments were to be continued later.

24-inch Reflector. 519 plates were taken by Mr. Van Biesbroeck and by Mr. Struve in continuation of their work on the faint asteroids. 119 positions relating to 56 objects were obtained; 43 asteroids sought for were not found within the limits of the plates. Mr. Van Biesbroeck obtained the following number of cometary positions:

Comet 1925 *a* Shajn—Comas Solá, 7; 1925 *b* Reid, 8; 1926 *c* Kopff, 5; 1926 *d* Finlay, 5; 1926 *e* Giacobini, 10; 1926 *g* Neujmin, 10.

Several plates were exposed on comets for recording their physical structure, tail, etc. The observations of comets were reduced immediately and sent for publication. Notes on comets were prepared by Mr. Van Biesbroeck for appearance each month in POPULAR ASTRONOMY.

The reflector was used in his photometric studies on planetary nebulae by W. H. Garrett on 18 nights, in whole or in part, during the summer of 1926, and progress was made in the evaluation of his results.

Bruce Photographic Telescope. 77 fields were photographed for proper-motion stars and variable stars by Mr. Ross. He continued his comparison, with the blink machine, of these fields with plates secured 15 or more years earlier by Professor Barnard, and he published in *The Astronomical Journal* his fifth and sixth lists of stars having proper motions greater than 0″.10, thus advancing his number of such stars from 541 to 680. The largest proper motion was 5″.40 for a star of the 13th magnitude, No. 619 of his list. This star is in Cancer in the position $\alpha = 8^h\ 05^m\ 06^s$; $\delta = +9°\ 14'.8$ (1875). This survey has brought to light additional new variable stars of which he published two further lists, with a total of 81 stars.

The following plates were taken of different fields by Mr. Pogo, including one of the Pons-Winnecke Comet: 27 with the 10-inch lens; 4 with the 6-inch lens; 19 with the Ross 3-inch lens.

General. After his return to the Observatory, Mr. Ross made careful experiments in preparing enlargements of his photographs of the planet Mars, and in improving the technique by the use of plates sensitive to the infra-red in the copying process. His results appeared in *The Astrophysical Journal* for November, 1926.

Mr. Bobrovnikoff continued his investigations on comets, and passed

his examination for the Doctor's Degree on June 3, 1927, his thesis being entitled *Investigations on the Nature and Physical Properties of Comets.* His thesis was too long for complete publication, but two papers based upon it will appear in *The Astrophysical Journal.*

Four photographs of the spectrum of comet Pons-Winnecke were obtained by Mr. Pogo with the Zeiss U-V and the results are to appear in a joint paper by Messrs. Bobrovnikoff and Pogo in POPULAR ASTRONOMY.

Mr. William R. Paul, of Chicago, made eight trips to the Observatory, sweeping the sky for comets with the 6-inch comet seeker on nine nights in different parts of the year.

With the 12-inch telescope Mr. Morgan, by the Argelander method, made 163 observations of 13 variable stars on 27 nights. He made 10 extra-focal exposures on the star CP Cygni, with the Zeiss U-V Doublet, and found no variability in magnitude. He also measured several plates of this star taken with the Bruce Spectrograph.

Mr. Richard A. Robb made a comparative study of the determination of color indices by the method of effective wave-lengths, as employed here previously by Mr. Vanderlinden, and by the method of filters as used by Mr. Parkhurst. The fields were two Kapteyn Areas. His conclusions that atmospheric conditions affected the former method were given in a paper in *The Astrophysical Journal* for June, 1927.

The manuscript for Parts I and II of the Barnard "Atlas of the Selected Regions of the Milky Way" was completed by the Director and Miss Calvert and the proofs of the key charts were minutely corrected by Miss Calvert. The proof sheets were read, and nearly all printing completed by the University of Chicago Press for the Carnegie Institution of Washington by the end of June.

Professor Barnard's unpublished visual measures with the micrometer of the 40-inch telescope of the satellites of Saturn from 1917 to 1922, and of those of Uranus and of the satellite of Neptune from 1919 to 1922, were extracted from the observing books and prepared for publication by Miss Calvert. Measures of the position angles of Saturn's rings on 56 nights and of the position of Neptune on 14 nights were also included in these papers, which appeared in *The Astronomical Journal,* Nos. 879 and 883. This completes the publication of Mr. Barnard's series of measures of these planets and satellites.

The proof sheets of Mr. Parkhurst's paper on the "Photographic Magnitudes and Color Indices of 1550 Stars in the 24 Kapteyn Fields at Declination +45°" were read and checked by Miss Farnsworth in June.

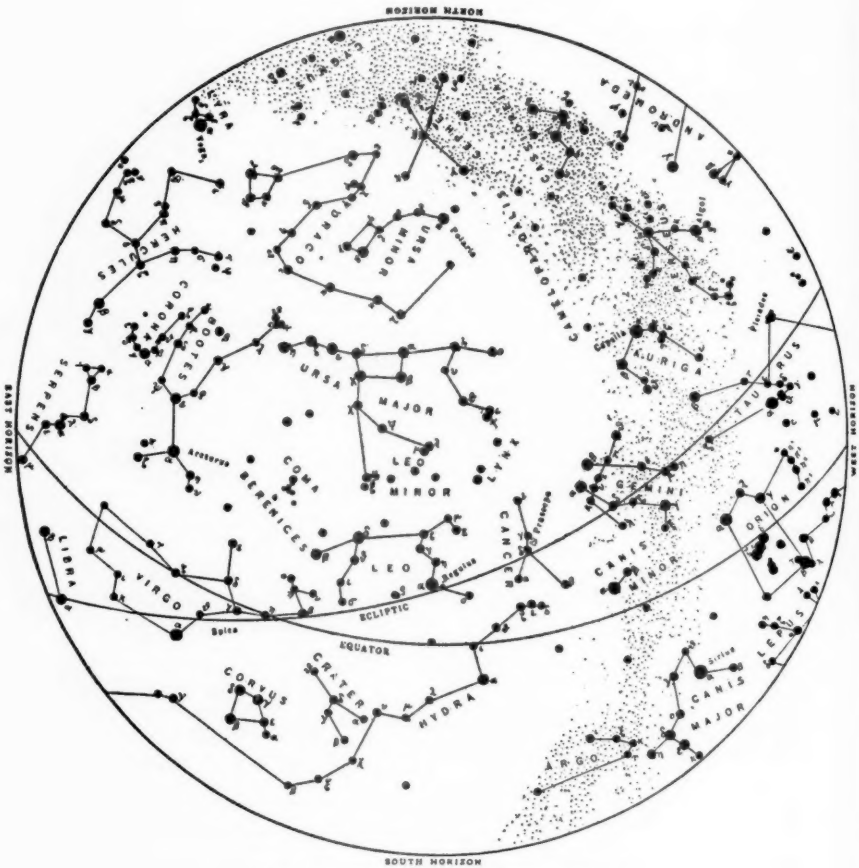
The Library. The additions during the year were 242 bound volumes and 173 pamphlets. Of the former, 119 were completed volumes of serials, and 123 were new books.

The visitors to the Observatory during the fiscal year numbered 11,722.

EDWIN B. FROST, *Director.*

PLANET NOTES FOR APRIL.

By CLIFFORD E. SMITH.



THE CONSTELLATIONS AT 9:00 P.M. APRIL 1.

The *Sun* will be moving northeast from the central part of Pisces to the central part of Aries. The position of the sun on April 1 and April 30, respectively, will be: R.A. $0^h\ 41^m$, Decl. $+4°\ 22'$; R.A. $2^h\ 28^m$, Decl. $+14°\ 38'$.

The phases of the *Moon* will occur as follows:

Full Moon	April	4 at 10 P.M.	C.S.T.
Last Quarter		13 " 2 A.M.	"
New Moon		19 " 11 P.M.	"
First Quarter		26 " 4 P.M.	"

The moon will be at apogee (farthest from the earth) on April 8, and at perigee (nearest the earth) on April 20.

Mercury will be moving northeast from the western edge of Pisces to the western edge of Aries. It will be west of the sun, but its elongation (angular distance from the sun) will continually decrease. At the beginning of the month it will rise about an hour and a half before the sun. Mercury will be in conjunction with planets during the month as follows: Venus on April 8, Uranus on April 13, Jupiter on April 22.

Venus will be moving northeast from the western part to the eastern part of the constellation of Pisces. Like Mercury it will be west of the sun, rising about an hour and a quarter before the sun the first of the month. Also like Mercury its elongation will continually decrease during the month. Venus will be in conjunction with Mercury on April 8, with Uranus on April 15, and with Jupiter on April 29.

Mars will be in Aquarius, moving northeast. It will be west of the sun, and during the middle of the month it will rise about three hours before the sun.

Jupiter will be near the sun. On April 6 it will be in conjunction with the sun. On April 22 Jupiter will be in conjunction with Mercury, and on April 29 it will be in conjunction with Venus.

Saturn will be visible most of the night in Ophiuchus, somewhat north and and about twelve degrees east of Antares. During the middle of the month it will rise about 10:00 P.M. Standard Time.

Uranus will be in the central part of Pisces near the sun. On April 13 it will be in conjunction with Mercury and on April 15 it will be in conjunction with Venus.

Neptune will be in Leo near Regulus (α Leonis). It will be visible most of the evening hours since quadrature east of the sun will occur in May.

Occultations Visible at Washington.

[From the *American Ephemeris.*]

Date 1928	Star's Name	Magnitude	IMMERSION. Washington C.T.	IMMERSION. Angle from N	EMERSION. Washington C.T.	EMERSION. Angle from N	Duration
			h m	°	h m	°	h m
Apr. 9	84 B. Scorpii	6.3	1 11	42	1 32	13	0 22
12	σ Sagittarii	2.1	3 4	91	4 32	279	1 28
15	143 B. Capricorni	6.1	4 27	45	5 33	283	1 6
23	132 Tauri	5.0	19 59	81	20 59	282	1 0
25	5 B. Cancri	6.4	23 37	135	0 24	255	0 46

METEOR NOTES.

By CHARLES P. OLIVIER.

During the last three months we have had the pleasure of admitting to membership in the American Meteor Society the following:

S. A. E. Betz, 301 Calhoun St., Cincinnati, Ohio.
Miss Fay L. Brinkman, Chester, Montana.
Victor Daly, 2021 Anthony Ave., New York, N. Y.
Clinton B. Ford, 904 Forest Ave., Ann Arbor, Mich.

Miss Margaret Harwood, Maria Mitchell Observatory, Nantucket, Mass.
E. J. Knoll, Jr., 908 Sixth St., Allentown, Pa.
Willis W. Waite, M. D., 522 Roberts-Banner Bldg., El Paso, Texas.

Due to winter temperatures and the general absence of meteor showers of importance, except the Quadrantids, January and February are months in which we receive few observations. To date only three sets have come in, one by Olivier on January 3, and one each by Sterling Bunch and O. E. Monnig for January 14. We have also received a single report of a brilliant fireball seen February 9 at 11:30 P.M., in North Carolina by K. S. Shepherd; and another on February 12 at 7:30 P.M., at Kenosha, Wis., by Wm. H. Schroeder. Further observations of these objects are greatly to be desired.

The observations of January 3 by Olivier were on the Quadrantids. Watch was kept from 16:25 to 17:27 and from 18:00 to 18:20; 17 meteors being seen in the first interval and 4 in the second. There were 4 Quadrantids of magnitude —1 to —3, and the shower was quite active, evidently furnishing many brilliant objects. A preliminary measurement of the maps gives the radiant at $\alpha = 224°$, $\delta = +54°$, based on 9 paths, well distributed. The radiant area was a circle 4° to 5° in diameter.

On January 14, Bunch and Monnig observed together, but toward different quadrants. Watch was kept from 10:14 to 13:00, 13 meteors and 6 meteors being plotted respectively, 2 being duplicates. There was no shower of importance in activity.

Further reports have been received from R. M. Dole at East Lansing, Mich., as to his very successful work in October. The following table gives the brief résumé of numbers, sent on by him:

Date	Orionids	Others	Total
1927 Oct. 18	7	2	9
19	3	8	11
20	2	0	2
21	64	13	77
23	97	39	136
24	44	49	93
25	41	37	78
26	41	25	66
27	51	24	75
30	..	12	12
31	32	31	63
Nov. 2	18	20	38
Total	400	260	660

He reports the shower a brilliant one, and that the radiant moved from near ρ Orionis on October 18 to near λ Geminorum on November 2. He had excellent weather for his observations. A study of his maps should give many minor radiants. He reports bad weather for the Leonids and later showers.

We hope that all our members will keep carefully in mind the Lyrids of April and the Eta Aquarids of May. Both showers need all the observations we can get. We now have on hand, thanks to the generosity of one of our members, A. S. Lawrence, plenty of blanks for both visual and telescopic meteors. These will from now on be furnished on application.

Leander McCormick Observatory, University of Virginia, 1928 Feb. 20.

VARIABLE STARS.

Minima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Minima in 1928 April							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8					22 14			
RT Sculptor.	31.5	—26 13	9.6—10.5	0 12.3	2 6		9 10		16 13		23 17	
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	7 10		14 12		22 0		29 11	
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	1 10		7 13		19 18		25 21	
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	1 21		13 8		19 1		30 11	
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	4 14		11 11		18 8		25 4	
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	3 5		12 18		17 13		27 3	
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	5 2		13 1		21 0		28 23	
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6							27 6	
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	4 9		12 23		21 14		30 4	
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	4 6		10 5		22 2		28 1	
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	4 18		12 16		19 13		28 11	
RW Tauri	3 57.8	+27 51	7.1— [11	2 18.5	2 10		10 17		19 1		27 8	
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	4 21		10 19		22 15		28 13	
RW Persei	13.3	+42 04	8.8—11.0	13 04.8			13 9				27 3	
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	4 14		10 21		23 11		**29 18**	
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	1 11		13 21				26 7	
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	5 14		11 2		22 4		**27 17**	
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	4 19		10 6		21 3		26 14	
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	4 13		10 14		22 15		28 16	
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	1 10		7 22		20 22		27 10	
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	5 4		10 9		20 19		26 0	
SV Gemin.	54.6	+24 28	9.8— [11	4 00.2	8 1		16 1				24 1	
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	6 17		12 11		23 22		29 15	
U Columbæ	6 11.2	—33 03	9.2—10.0	2 19.2	2 13		8 19		21 6		27 12	
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	5 20		12 16		19 12		**26 8**	
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7			8 14		16 5		23 20	
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0			7 13		19 18			
RU Monoc.	6 49.4	— 7 28	9.8—10.5	0 21.5	2 20		10 1		17 5		24 9	
R Can. Maj.	7 14.9	—16 12	5.8— 6.4	1 03.3	5 10		12 6		19 1		25 21	
RY Gemin.	21.7	+15 52	8.9— [10	9 07.2			7 22		17 6		26 13	
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	4 1		10 15		23 20		30 11	
TX Gemin.	30.3	+17 08	10.0—11.9	2 19.2	2 20		11 6		19 16		28 1	
RR Puppis	43.5	—41 08	9.4—10.7	6 10.3	5 6		11 16		24 13		30 23	
V Puppis	7 55.4	—48 58	4.1— 4.8	1 10.9	4 6		11 12		18 19		26 1	
X Carinæ	8 29.1	—58 53	7.9— 8.7	0 13.0	1 15		8 16		22 18		29 19	
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	1 13		11 1		20 12		30 0	
RX Hydræ	9 00.8	— 7 52	9.1—10.5	2 06.8	4 13		13 16		22 19			
S Velorum	29.4	—44 46	7.8— 9.3	5 22.4	3 4		9 2		20 23		26 21	
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	3 13		10 7		23 19		30 13	
RR Velorum	10 17.8	—41 36	10.0—10.9	1 20.5	5 15		13 1		20 11		27 21	
SS Carinæ	54.2	—61 23	12.2—12.8	3 07.2	3 15		10 5		23 10		30 1	
RW Urs. Maj.	10 35.4	+52 34	10.3—11.4	7 07.9	4 11		11 19		19 3		26 11	
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	4 20		11 15		18 10		25 5	
RZ Centauri	12 55.6	—64 05	8.5— 8.9	1 21.0	6 19		14 7		21 19		29 7	
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.1	4 17		13 7		18 2		27 17	
SS Centauri	07.2	—63 37	8.8—10.4	2 11.5	7 2		14 12		21 22		29 9	

Minima of Variable Stars of Short Period—Continued.

Star	R.A. 1900		Decl. 1900		Magnitude	Approx. Period		Greenwich civil times of Minima in 1928 April							
	h	m	°	′		d	h	d	h	d	h	d	h	d	h
SX Hydræ	13	39.0	−26	23	8.6—12.7	2	21.5	3	6	9	1	20	15	26	10
δ Libræ	14	55.6	− 8	07	4.8— 6.2	2	07.9	1	11	8	11	22	10	29	10
U Coronæ	15	14.1	+32	01	7.6— 8.7	3	10.9	7	11	14	9	21	7	28	4
TW Draconis	15	32.4	+64	14	7.3— 8.9	2	19.4	2	14	11	0	19	10	27	21
SS Libræ	15	43.4	−15	14	9.3—11.5	0	18.4	3	18	10	23	18	4	25	8
SW Ophiuchi	16	11.1	− 6	44	9.2—10.0	2	10.7	5	18	13	2	20	10	27	18
SX Ophiuchi		12.6	− 6	25	10.5—11.2	2	01.5	3	19	9	23	22	8	28	13
R Aræ		31.1	−56	48	6.8— 7.9	4	10.2	8	3	16	23			25	20
TT Herculis	16	49.9	+17	00	8.9— 9.3	20	18.1					18	15		
TU Herculis	17	09.8	+30	50	9.5—12	2	06.4	6	5	13	0	19	19	26	14
U Ophiuchi		11.5	+ 1	19	6.0— 6.7	1	16.2	3	11	10	4	23	14	30	7
ω Herculis		13.6	+33	12	4.6— 5.4	2	01.2	2	22	9	1	21	9	27	12
TX Herculis		15.4	+42	00	8.3— 9.0	2	01.4	1	21	8	1	20	10	26	14
RV Ophiuchi		29.8	+ 7	19	9. —12	3	16.5	6	17	14	2	21	11	28	19
SZ Herculis		36.0	+33	01	9.5—10.3	0	19.6	2	7	12	3	17	1	26	20
TX Scorpii		48.6	−34	13	7.5— 8.2	0	22.6	2	4	8	18	21	23	28	13
UX Herculis		49.7	+16	57	8.8—10.5	1	13.2	7	10			18	6	29	3
Z Herculis		53.6	+15	09	7.1— 7.9	3	23.8	7	18	15	18	23	17		
WX Sagittarii		53.6	−17	24	9.2—10.8	2	03.1	6	2	12	12	18	21	25	6
WY Sagittarii	17	54.9	−23	01	9.5—10.6	4	16.0	2	3	11	11	20	19	30	3
SX Draconis	18	03.0	+58	23	9.3—10.5	5	04.1	4	23	15	7	20	11	30	19
RS Sagittarii		11.0	−34	08	5.9— 6.3	2	10.0	4	1	11	7	18	13	25	19
V Serpentis		11.1	−15	34	9.5—11.1	3	10.9	6	9	13	16	20	14	27	12
RZ Scuti		21.1	− 9	15	7.4— 8.3	15	03.2			15	16			30	20
RZ Draconis		21.8	+58	50	9.5—10.2	0	13.2	1	16	9	9	17	2	24	19
RX Herculis		26.0	+12	32	7.0— 7.6	0	21.3	7	7			16	5	25	2
SX Sagittarii		39.7	−30	36	8.7— 9.8	2	01.8	1	22	10	6	18	12	26	20
RR Draconis		40.8	+62	34	9.3—13	2	19.9	5	3	13	15	22	3	30	15
RS Scuti		43.7	−10	21	9.3—10.3	0	15.9	5	9	13	8	21	7	29	7
β Lyræ		46.4	+33	15	3.4— 4.1	12	21.8			12	9			25	7
U Scuti	18	48.9	−12	44	9.1— 9.6	0	22.9	8	16	14	16	23	21		
RX Draconis	19	01.1	+58	35	9.3—10.2	1	21.4	7	11	15	1	22	15	30	4
RV Lyræ		12.5	+32	15	11. —12.8	3	14.4	3	2	10	6	17	11	24	16
RS Vulpec.		13.4	+22	16	6.9— 8.0	4	11.4	3	0	11	23	20	22	29	21
U Sagittæ		14.4	+19	26	6.5— 9.0	3	09.1	5	11	12	5	18	23	25	18
Z Vulpec.		17.5	+25	23	7.3— 8.5	2	10.9	6	16	14	1	21	10	28	19
TT Lyræ		24.3	+41	30	9.4—11.6	5	05.8	7	10	12	16	23	3	28	9
UZ Draconis		26.1	+68	44	9.0— 9.8	1	15.1	7	3	15	6	23	10	26	14
SY Cygni	19	42.7	+32	28	10. —12	6	00.2	4	4	10	4	22	4	28	4
WW Cygni	20	00.6	+41	18	9.3—13.4	3	07.6	8	17			18	16	28	15
SW Cygni		03.8	+46	01	9. —11.7	4	13.8	4	15	13	19	22	22		
VW Cygni		11.4	+34	12	9.8—11.8	8	10.3	7	6	15	16			24	3
RW Cancri.		12.2	−17	59	8.8—10.6	3	09.4	6	12	13	7	20	2	26	20
UW Cygni		19.6	+42	55	10.5—13	3	10.8	5	23	12	21	19	19	26	16
V Vulpec.		32.3	+26	15	8.2— 9.8	37	19.0	3	9						
W Delphini		33.1	+17	56	9.4—12.1	4	19.4			7	8	17	9	26	23
RR Delphini		38.9	+13	35	10.5—11.8	4	14.4	3	19	13	0	17	14	26	19
Y Cygni		48.1	+34	17	7.1— 7.9	2	23.9	6	9	12	9	24	9	30	8
WZ Cygni		49.3	+38	27	9.9—10.8	0	14.0	2	3	9	6	23	13	30	16
RR Vulpec.	20	50.5	+27	32	9.6—11.0	5	01.2	1	12	11	15	16	16	26	18
RY Aquarii	21	14.8	−11	14	8.8—10.4	1	23.2	4	18	10	16	22	11	28	8
UZ Cygni		55.2	+43	52	8.9—11.6	31	07.3					18	3		
RT Lacertæ	21	57.4	+43	24	9.1—10.5	5	01.7	1	21	12	1	17	2	27	6
RW Lacertæ	22	40.6	+49	08	10.2—11.2	5	04.4	4	11	14	19	20	0	30	8
VW Pegasi	22	51.7	+32	42	10.0—10.6	5	06.4	4	16	9	23	20	13	25	20
Y Piscium	23	29.3	+ 7	22	9.0—12.0	3	18.4	4	13	12	1	19	14	27	3
TW Androm.	23	58.2	+32	17	8.6—11.5	4	02.9	4	2	12	8	20	14	28	20

Maxima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Maxima in 1928 April							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7								
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 01.7	4 16	12 19	20 23	29 2				
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	2 23	14 1	19 13	30 15				
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2		14 0		28 19				
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	6 0	12 23	19 22	26 20				
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	1 6	9 1	16 20	24 15				
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0		16 15						
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	3 17	12 7	20 21	29 11				
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	6 1		17 4	28 8				
RX Aurigæ	4 54.5	+39 49	7.2— 8.1	11 15.0	1 8	12 23	24 14					
SX Aurigæ	5 04.6	+42 02	8.0— 8.7	1 12.8	1 9	7 12	19 19	25 22				
SY Aurigæ	05.5	+42 41	8.4— 9.5	10 03.3		8 15	18 19	28 22				
Y Aurigæ	21.5	+42 21	8.6— 9.6	3 20.6	6 17	14 12	22 5	29 22				
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	4 17	10 6	21 7	26 20				
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	3 21	11 10	19 0	26 13				
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3		13 11						
RT Aurigæ	23.0	+30 33	5.1— 6.0	3 17.5	2 0	9 11	16 22	24 9				
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0		8 8	16 6	24 4				
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	5 1	15 5		25 9				
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5		14 20						
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	1 21	9 19	17 18	25 17				
V Carinæ	8 26.7	—59 47	7.4— 8.1	6 16.7	7 10	14 3	20 20	27 12				
T Velorum	8 34.4	—47 01	7.6— 8.5	4 15.3	3 21	13 3	17 19	27 1				
V Velorum	9 19.2	—55 32	7.5— 8.2	4 08.9	4 20	13 14	17 23	26 17				
Z Leonis	9 46.4	+27 22	7.9— 9.6	56 08.7								
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	2 19	11 21	20 22	29 23				
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	1 18	8 9	21 14	28 4				
S Muscæ	12 07.4	—69 36	6.4— 7.3	9 15.8	6 8	16 1		25 16				
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	1 19	13 5	18 22	30 7				
T Crucis	15.9	—61 44	6.8— 7.6	6 17.6	5 13	12 7	19 0	25 18				
R Crucis	18.1	—61 04	6.8— 7.9	5 19.8	6 17	12 13	24 4	30 0				
S Crucis	12 48.4	—57 53	6.5— 7.6	4 16.6	3 12	12 21	17 13	26 11				
W Virginis	13 20.9	— 2 52	8.7—10.4	17 06.5		14 4						
SS Hydræ	25.0	—23 08	7.4— 8.1	8 04.8	4 12	12 17	20 22	29 3				
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	2 19	12 4	21 13	30 21				
ST Virginis	14 22.5	— 0 27	10.3—11.4	0 09.9	7 22	16 3		24 8				
V Centauri	25.4	—56 27	6.4— 7.8	5 11.9	1 3	12 3	17 15	28 14				
RS Bootis	14 29.3	+32 11	8.9—10.0	0 09.1	7 8	14 21	22 10	30 0				
R Trian. Austr.	15 10.8	—66 08	6.7— 7.4	3 09.3	1 22	12 2	18 21	29 1				
S Trian. Austr.	15 52.2	—63 29	6.4— 7.4	6 07.8	5 5	12 13	18 21	25 4				
S Normæ	16 10.6	—57 39	6.6— 7.6	9 18.1	1 8	11 2	20 20	30 14				
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	3 8	9 23	23 6	29 22				
RV Scorpii	16 51.8	—33 27	6.7— 7.4	6 01.5	1 8	7 10	19 13	25 14				
X Sagittarii	17 41.3	—27 48	4.4— 5.0	7 00.3	5 0	12 0	19 0	26 1				
Y Ophiuchi	47.3	— 6 07	6.1— 6.5	17 02.9		16 5						
W Sagittarii	17 58.6	—29 35	4.3— 5.1	7 14.3	0 13	8 4	15 18	23 8				
Y Sagittarii	18 15.5	—18 54	5.4— 6.2	5 18.6	5 3	10 20	22 11	28 5				
U Sagittarii	26.0	—19 12	6.5— 7.3	6 17.9	5 20	12 14	19 8	26 2				
Y Scuti	32.6	— 8 27	8.7— 9.2	10 08.3	3 8	13 17		24 1				
RZ Lyræ	39.9	+32 42	9.9—11.2	0 12.3	1 5	8 22	16 13	24 6				
RT Scuti	44.1	—10 30	9.1— 9.7	0 11.9	6 1	13 11	20 21	28 7				
κ Pavonis	18 46.6	—67 22	3.8— 5.2	9 02.2	2 4	11 6	20 9	29 11				

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Maxima in 1928 April							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
U Aquilæ	19 24.0	— 7 15	6.2— 6.9	7 00.6	5 9	12 10	19 10	26 11				
XZ Cygni	30.4	+56 10	8.6— 9.3	0 11.2	0 4	7 4	21 4	28 4				
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	1 19	9 19	14 18	25 18				
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	2 20	10 13	18 6	25 22				
η Aquilæ	47.4	+ 0 45	3.7— 4.5	7 04.2	4 12	11 16	18 20	26 1				
S Sagittæ	51.5	+16 22	5.6— 6.4	8 09.2	7 21	16 6		24 16				
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	1 1	7 8	19 23	26 7				
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3		9 20		26 5				
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	1 10	10 6	19 3	28 0				
UY Cygni	52.3	+30 03	9.6—10.4	0 13.5	4 13	10 4	21 9	27 0				
RV Capric.	55.9	—15 37	9.2—10.1	0 10.7	3 5	12 4	21 3	30 2				
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4		13 16		28 8				
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	6 7	14 4	22 0	29 21				
SW Aquarii	10.2	— 0 20	9.9—10.8	0 11.0	1 2	10 7	19 11	28 16				
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	3 16	13 9	18 6	28 0				
Y Lacertæ	22 05.2	+50 33	9.1— 9.6	4 07.8	4 10	13 2	17 10	26 1				
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	1 1	11 19	17 4	27 21				
Z Lacertæ	36.9	+56 18	8.2— 9.0	10 21.1		11 3	22 0					
RR Lacertæ	37.5	+55 55	8.5— 9.2	6 10.1	3 6	9 16	22 12	28 22				
V Lacertæ	44.5	+55 48	8.5— 9.5	4 23.6	1 8	11 7	16 7	26 6				
X Lacertæ	22 45.0	+55 54	8.2— 8.6	5 10.7	4 21	10 8	21 5	26 16				
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	1 16	12 13	18 0	28 21				
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	3 7	9 15	22 5	28 12				
RY Cassiop.	23 47.2	+58 11	9.3—11.8	12 03.4	3 7	15 10		27 14				

Monthly Report of the American Association of Variable Star Observers, for the Month of January, 1928.

We welcome reports this month from three new contributors, Messrs. M. Furuhata, of Japan; G. D. Kendall, of Houston, Texas; and R. I. Wolff, of the College of the City of New York. A good list is also at hand from our former observer, Mr. Sterling Bunch, of Fort Worth, Texas, who comes back to the active list after a silence of several years.

President D. B. Pickering delivered an illustrated lecture on the "Romance of Variable Star Observing" before a large and enthusiastic audience made up of the members of the American Amateur Astronomical Association in New York on January 19. Miss A. S. Young addresses the same body this month on "The 1927 Solar Eclipse." Reports from Usseppa Island indicate that Secretary Olcott, who was so seriously ill during December, is fast returning to his normal good health.

Our members will be glad to learn that Mr. W. F. H. Waterfield, who did such fine work for us on the variables with his 12-inch reflector while in Nakusp, B. C., and who since 1926 has been on the staff of the Harvard Observatory making photographic observations of variables, will leave within a few weeks for South Africa. He goes to assume the position of Chief Assistant of the Boyden Station of Harvard at Mazelsport, near Bloemfontein. Mr. Waterfield, since his residence in Cambridge, has been acting head of the Chart Committee, and has shown himself a true supporter of the activities of the AAVSO. We all wish him well in his new surroundings, and look forward to his safe return in 1933, when we hope he will take a still greater part in our activities.

Variable Star Observations Received During January, 1928.

Nov. 0 = J.D. 2425185; Dec. 0 = J.D. 2425215; Jan. 0 = J.D. 2425246.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V Scl	R And	X Scl	RZ Per	W And	U Cet
000330	001838	*004435*	012350	021143a	*022813*
200 13.2 Bl	234 10.7 Pt	182 10.6 Bl	263 10.0 Sp	263 12 0 Kz	231 8.6 Ch
210 12.8 Bl	241 11.1 Pn	199 10.6 Bl	263 9.9 Kz	263 11.8 Eb	231 8.4 Pt
S Scl	244 11.3 B	210 10.7 Bl	263 10.1 Eb	T Per	244 8.4 Gy
001032	250 11.2 Pn	RR And	R Psc	021258	RR Cep
188 7.5 Ht	261 11.5 Al	004533	012502	230 8.9 Ch	022980
192 7.7 Bl	263 10.2 Eb	201[14.6 Bg	206 11.1 Bg	231 8.5 Pt	231 12.3 Pt
196 7.0 En	263 11.7 Kz	207 15.2 Bg	210 10.8 Ch	o Cet	233 12.7 L
198 7.6 Ht	263 11.7 Pn	214 14.8 Bg	232 8.4 Ch	*021403*	234 12.4 Lg
199 7.7 Bl	S Tuc	RV Cas	234 8.2 Pt	196 5 0 En	243 12.7 Kn
202 7.6 Sm	*001862*	004746a	242 8.2 Al	198 5.3 En	243 12.7 Lg
204 7.8 Ht	200[14.0 Bl	242 14.3 B	263 7.7 Eb	201 5.1 Sm	R Tri
206 7.5 En	201[13.2 Sm	— Cas	263 7.5 Kz	202 5.4 En	023133
209 7.9 Ht	206[11.9 En	004746b	RU And	203 5.2 Fu	221 6.8 Ch
210 7.9 Bl	213[12.4 En	234 10.6 Pt	013238	204 5.4 Fu	231 6.7 Pt
212 7.8 En	S Cet	263 10.8 Kz	230 10.8 Ch	208 5.6 Fu	232 6.8 Jo
234 8.5 Pt	*001909*	263 10.7 Eb	234 10.6 Pt	208 5.4 Ch	237 7.0 Jo
261 9.8 Bh	214[11.7 Ch	W Cas	238 10.5 Lg	211 5.5 Ch	240 7.1 Jo
X And	228[13.3 L	004958	244 10.6 B	212 5.7 Fu	244 7.5 Gy
001046	240[13.3 Ie	227 9.6 B	247 10.7 Lg	213 5.8 En	255 8.0 Gs
201 12.8 Bg	247[13.7 Lg	232 8.9 Jo	263 10.9 Kz	215 5.7 Ch	257 8.2 B
207 12.8 Bg	T Phe	234 9.3 Pt	263 11.1 Eb	223 6 6 Ch	260 8.1 Kz
214 12.9 Bg	*002546*	237 9.0 Jo	Y And	228 6.1 L	260 8.4 Eb
233 12.9 GC	197[12.2 En	240 9.2 Jo	013338	230 6.6 Ch	W Per
237 13.7 B	200 14.0 Bl	244 9.4 B	230 9.5 Ch	231 6.1 Pt	024356
T Cet	212[12.2 En	U Tuc	234 10.1 Pt	232 6.3 Jo	231 9.4 Pt
001620	T Psc	*005475*	244 10.6 B	234 6.7 Ch	257 9.6 B
T And	002614	192 11.5 Bl	263 11.6 Kz	235 6.3 Fu	259 9.4 Rt
233 6.5 L	224 12.6 GC	199 11.9 Bl	263 11.6 Eb	236 6.5 Fu	263 9.5 Kz
001726	233 11.8 GC	201 12.5 Sm	X Cas	240 6.6 Jo	263 9.9 Eb
213 9.9 Ch	W Scl	206 12.9 En	014958	242 6.3 Fu	R Hor
229 9.1 Ch	*002833*	210 12.8 Bl	234 11.9 Pt	243 6.4 Fu	*025050*
234 8.8 Pt	200 13.0 Bl	213 13.4 En	244 10.7 B	244 6.8 Fu	188 10 8 Ht
242 8.9 B	U Cas	Z Cet	255 11.8 Bn	244 7.2 Gy	188 11.2 Sm
242 8.9 Ie	004047	*010102*	U Per	245 6.8 Fu	192 10.1 Bl
253 8.9 Eb	234 8.9 Pt	234 10.5 Pt	015254	248 6.4 Gs	196 10.2 En
253 8.5 Kz	240 9.2 Ie	U Scl	234 10.1 Pt	S Per	198 9.9 Ht
259 9.0 Rt	242 8.3 Cl	*010630*	244 10.2 B	021558	202 10.2 En
263 8.9 Kz	242 8.7 B	200[13.2 Bl	263 9.8 Kz	230 9.3 Ch	202 9.6 Sm
263 9.0 Eb	253 8.3 Eb	U And	263 10.0 Eb	231 8.9 Pt	204 9.5 Ht
T Cas	253 8.4 Kz	010940	R Ari	233 9.5 GC	206 8.6 En
001755	259 8.8 Rt	234 13.3 Lg	021024	237 9.4 B	209 8.4 Ht
235 11.7 B	263 8.7 Kz	237 13.5 B	221 8.7 Ch	242 9.4 B	210 9.0 Sm
242 11.5 Ie	263 8.9 Eb	243 13.4 Lg	232 8.2 Jo	257 9.2 B	210 8.3 Bl
253 11.2 Eb	RW And	263 11.9 Kz	234 8.2 Pt	R Cet	213 7.6 En
253 11.1 Kz	004132	263 11.9 Eb	236 9.4 Fd	*022000*	T Hor
263 10.6 Kz	230[11.5 Ch	S Psc	238 8.8 Fd	210 8.2 Ch	*025751*
263 10.3 Eb	V And	011208	240 8.3 Jo	235 10.4 Ch	188 10.5 Sm
261 11.1 Al	004435	237 14.1 B	241 9.0 Fd	260 10.9 Kz	192 10.0 Bl
R And	201 10.2 Bg	U Psc	256 9.0 Fd	260 11.1 Eb	199 9.8 Bl
001838	207 10.0 Bg	011712	256 8.5 Gb	R For	202 9 2 Sm
206 10.2 Wm	214 9.6 Bg	234 11.7 Pt	257 9.0 B	*022426*	210 9.8 Sm
212 10.4 Wm	233 9.5 GC	244 11.5 Lg	259 7.8 Rt	192 8.8 Bl	210 9.5 Bl
213 10.2 Ch	237 9.6 B	RZ Per	263 9.8 Pn	199 9.5 Bl	U Ari
217 10.6 Wm	263 10.3 Kz	012350	W And	210 8.6 Bl	030514
226 10.9 Wm	263 10.2 Eb	237 10.1 B	021143a	U Cet	203 14.3 Bf
227 10.5 B		242 10.2 B	234 12.1 Pt	*022813*	
233 11.1 Al		257 9.8 B	257 11.6 B	214 10.2 Ch	

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1928.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
X CET	RX TAU	R PIC	S PIC	T ORI	SU TAU
031401	043208	*044349*	*050848*	*053005a*	054319
231 8.5 Pt	228 10.6 B	192 8.0 Bl	213 8.6 En	231 9.7 Pt	244 9.6 Pt
232 8.9 Jo	231 10.6 Pt	198 8.8 En	R AUR	236 9.7 Pt	247 9.4 Lg
233 9.5 L	260 10.9 Kz	199 8.8 Bl	050953	237 9.7 GC	248 9.6 Pt
237 8.8 Jo	260 11.2 Eb	206 9.0 En	231 8.6 Pt	239 9.7 Pt	249 9.4 Lg
241 9.1 Cl	R RET	210 9.1 Bl	260 8.2 Kz	241 9.9 Pt	249 9.6 Pt
260 8.9 Eb	*043263*	211 9.2 Ht	260 8.3 Eb	242 10.9 Sp	252 9.6 Pt
260 8.7 Kz	188 11.5 Ht	213 9.2 En	261 8.1 Al	246 10.8 L	255 9.5 Bh
Y PER	188 11.4 Sm	V TAU	T PIC	248 10.5 Pt	256 9.5 Bh
032043	192 11.1 Bl	044617	*051247*	249 10.4 Pt	256 9.6 Pt
231 8.5 Pt	196 11.0 En	228 12.3 B	188 10.6 Ht	252 10.6 Pt	257 9.5 Bh
263 8.4 Kz	198 11.0 Ht	238 12.2 GC	192 10.3 Bl	256 10.4 Pt	258 9.5 Bh
263 8.5 Eb	199 11.1 Bl	243 11.4 Kn	198 10.0 Ht	256 10.2 B	259 9.5 Bh
R PER	202 11.0 En	243 11.4 Lg	199 9.0 Bl	263 10.2 Sp	260 9.4 Bh
032335	202 10.7 Sm	260 10.1 Kz	201 9.5 Sm	263 9.9 Kz	261 9.5 Bh
229 9.6 Lg	204 10.7 Ht	260 10.4 Eb	204 9.0 Ht	263 9.9 Eb	263 9.8 Eb
231 10.1 Pt	206 10.4 En	R ORI	209 8.8 Ht	S CAM	263 9.6 Kz
234 9.7 Lg	209 10.5 Ht	045307	210 8.7 Sm	053068	263 9.8 Sp
238 9.9 Lg	210 10.6 Bl	237 9.9 B	210 8.6 Bl	231 10.1 Pt	S COL
244 10.9 Lg	213 10.3 En	240 10.6 Ie	261 8.9 Bh	263 8.6 Kz	*054331*
247 11.2 Lg	215 10.1 Sm	263 10.6 Eb	T COL	263 9.0 Eb	192 11.6 Bl
263 12.8 Kz	X CAM	263 10.4 Kz	*051533*	RR TAU	197 11.5 En
263 12.6 Eb	043274	R LEP	188 9.6 Ht	053326	198 11.6 Ht
U CAM	211 11.8 Ch	*045514*	188 9.2 Sm	237 12.0 B	199 11.6 Bl
033362	231 8.5 Pt	211 9.3 Ch	192 9.2 Bl	241 11.7 GC	201 11.4 Sm
232 7.5 By	237 8.2 B	231 8.0 Pt	197 9.2 En	RU AUR	204 11.3 Ht
238 7.2 By	263 8.7 Kz	232 8.5 Jo	198 9.4 Ht	053337	206 10.8 En
T TAU	263 8.5 Eb	235 7.0 Fd	199 9.2 Bl	231 9.6 Pt	209 10.8 Ht
041619	R DOR	236 7.3 Fd	201 9.0 Sm	260 9.8 Kz	210 10.9 Sm
238 10.3 GC	*043562*	240 8.6 Jo	202 9.2 En	260 9.6 Eb	210 10.4 Bl
R TAU	188 5.5 Ht	246 8.3 L	204 8.9 Ht	U AUR	213 10.2 En
042209	188 5.5 Sm	V ORI	206 8.2 En	053531	Z TAU
203 8.5 Bf	192 5.0 Bl	050003	209 8.8 Ht	211 9.3 Ch	054615a
232 9.2 Jo	196 5.6 En	212 9.2 Ch	210 8.6 Sm	231 8.2 Pt	209 12.3 Bf
232 8.8 Ch	198 5.4 Ht	228 9.3 B	210 8.6 Bl	232 8.7 Ch	215 12.2 Bf
237 9.3 Jo	199 5.5 Bl	229 9.9 Lg	213 8.4 En	244 8.6 B	RW TAU
240 8.9 Ie	202 5.8 En	231 9.0 Ch	215 8.2 Sm	Y TAU	054615b
W TAU	202 5.8 Sm	231 9.7 Pt	257 8.3 Bh	053920	209 13.1 Bf
042215	204 5.4 Ht	234 9.9 Lg	S AUR	238 6.8 By	215 13.0 Bf
228 10.5 B	206 5.5 En	238 9.8 Lg	052034	241 6.9 Kl	R COL
231 10.8 Pt	209 5.6 Ht	240 9.8 Ie	211 9.0 Ch	243 7.0 Kl	*054629*
232 10.8 Jo	210 6.0 Bl	244 10.1 Lg	231 8.0 Pt	256 7.3 Fd	198 12.4 Ht
234 11.6 Al	213 5.8 En	263 11.2 Kz	232 8.9 Jo	SU TAU	200 13.0 Bl
237 11.0 Jo	215 5.8 Sm	263 11.2 Eb	237 9.1 Jo	054319	210 12.4 Sm
260 10.8 Kz	R CAE	T LEP	260 8.9 Kz	210 9.7 Ch	213 12.4 En
260 10.8 Eb	*043738*	*050022*	260 9.1 Eb	214 9.7 Ch	U ORI
S TAU	188 11.7 Ht	192 10.2 Bl	W AUR	218 9.8 Ch	054920a
042309	192 11.6 Bl	199 10.4 Bl	052036	227 9.8 Ch	210 7.9 Ch
203 14.5 Bf	198 11.7 En	210 9.7 Bl	211 12.1 Ch	231 9.8 Ch	227 8.6 Ch
T CAM	198 11.7 Ht	228 8.0 B	235 13.5 B	231 9.6 Pt	231 8.1 Pt
043065	199 11.6 Bl	231 8.9 Pt	S ORI	232 9.6 Pt	232 8.7 Jo
231 12.3 Pt	201 11.7 Sm	S PIC	*052404*	235 9.5 B	234 8.8 Pn
232 12.7 Lg	204 11.8 Ht	*050848*	231 9.9 Pt	236 9.6 L	235 8.7 Pn
233 12.3 L	206 11.8 En	192 11.9 Bl	237 10.0 B	236 9.6 Pt	235 8.8 Gb
238 12.7 Lg	209 12.0 Ht	197 9.5 En	263 9.6 Kz	238 9.6 Pt	235 8.8 Fd
239 12.2 GC	210 11.7 Bl	200 12.1 Bl	263 9.9 Eb	239 9.6 Pt	236 8.9 Fd
244 12.8 Lg	213 11.9 En	201 12.2 Sm	T ORI	241 9.6 Pt	237 8.6 B
		206 8.8 En	*053005a*	241 9.7 B	238 8.9 Fd
		210 12.9 Sm	228 10.0 B	242 9.3 Cl	239 9.0 Cb

Variable Star Observations Received During January, 1928.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
U Ori	V Aur	V CMi	S CMi	R Cnc	R Car
054920a	061647	070109	072708	081112	*092962*
240 8.7 Jo	228 11.5 B	246 11.2 Lg	240 7.5 Jo	223 11.0 Ch	198 9.4 Ht
241 8.4 Al	V Mon	R Gem	241 7.7 Al	232 10.7 Ch	199 9.2 Bl
241 8.8 Pn	*061702*	070122a	249 6.2 Al	239 9.7 Pt	202 9.4 Sm
250 8.7 Pn	229 6.9 Ch	210 6.0 Ch	256 9.0 Fd	Z Cam	204 9.5 Ht
252 8.7 Fd	231 7.2 Pt	229 6.3 Ch	257 8.2 B	081473	209 9.4 Ht
256 8.9 Fd	238 8.3 By	232 6.5 Jo	259 8.2 Rt	233 13.1 L	210 9.0 Bl
259 9.2 Fd	— Aur	239 6.9 Pt	260 8.0 Kz	V Cnc	213 9.5 En
259 9.2 Rt	062047	240 6.7 Jo	260 8.2 Eb	081617	X Hya
260 8.9 Eb	234 9.8 L	241 6.5 Al	261 8.1 Fd	223 8.0 Ch	*093014*
260 9.2 Kz	Z Mon	242 6.5 Al	T CMi	239 7.4 Pt	209 11.0 Bf
261 8.8 Al	*062808*	249 7.0 Al	072811	*082405*	215 11.1 Bf
261 9.0 Al	238 8.6 By	256 6.6 Fd	247 10.4 Lg	RT Hya	218 11.2 Ch
263 9.0 Pn	R Mon	256 6.9 B	256 11.5 B	239 7.4 Pt	239 11.5 Pt
UW Ori	063308	260 6.7 Kz	263 11.0 Sp	R Cha	R LMi
054920b	231 11.8 Pt	260 7.1 Eb	Z Pup	*082476*	093934
239 10.8 Cb	244 11.7 B	Z Gem	*072820b*	198[12.4 En	022 7.6 Fu
260 10.2 Eb	Nov Pic	070122b	209 13.5 Bt	200[12.6 Bl	023 7.7 Fu
260 10.4 Kz	*063462*	239 12.6 Pt	215 13.2 Bf	215[11.8 Sm	028 7.7 Fu
Z Aur	188 6.6 Ht	256 12.3 B	S Vol	S Hya	030 7.9 Fu
055353	188 6.3 Sm	TW Gem	*073173*	084803	032 7.8 Fu
211 10.6 Ch	198 6.6 Ht	070122c	198[12.5 En	223 8.9 Ch	239 12.5 Pt
229 9.9 Pt	198 6.6 En	239 8.0 Pt	200 12.6 Bl	231 8.0 Ch	R Leo
229 9.9 B	201 6.5 Sm	256 8.0 B	206[12 5 En	239 8.0 Pt	094211
231 9.5 Pt	204 6.7 Ht	R CMi	210 12.2 Bl	247 7.7 Lg	201 8.7 Fu
232 9.5 Pt	206 6.8 En	070310	U CMi	X Cnc	203 6.0 Fu
233 9.6 Pt	209 6.8 Ht	236 9.0 L	073508	084917	205 8.9 Fu
236 9.5 Pt	213 7.0 En	238 8.7 Lg	239 12.6 Pt	232 6.4 By	210 6.2 Fu
237 9.5 Pt	215 6.5 Sm	239 9.2 By	256 13.5 B	T Hya	211 6.1 Fu
238 9.5 Pt	S Lyn	246 9.1 Lg	S Gem	*085008*	212 6.0 Fu
239 9.5 Pt	063558	256 9.2 B	073723	223 7.5 Ch	218 6.2 Fu
241 9.5 Pt	228 13.8 B	260 9.6 Kz	239 14.5 Pt	231 7.2 Ch	223 6.4 Ch
242 9.5 Pt	X Gem	260 9.9 Eb	242 13.8 B	239 7.1 Pt	232 6.3 Jo
244 9.6 Pt	064030	R Vol	W Pup	247 7.8 Lg	235 6.6 Ch
248 10.0 Pt	242 11.0 Sp	*070772*	*074241*	T Cnc	236 6.4 Fd
249 10.0 Pt	244 10.8 B	198 12.6 Ht	188 8.5 Ht	085120	238 6.5 Fd
252 9.6 Pt	255 9.7 Bn	201 12.6 Sm	192 7.7 Bl	223 8.4 Ch	239 6.0 Pt
256 9.6 Pt	263 9.5 Sp	204[12.6 Ht	198 7.6 Ht	239 8.1 Pt	240 6.4 Jo
260 10.2 Eb	Y Mon	213[12.6 En	199 7.0 Bl	239 9.4 By	244 7.0 Fu
260 10.3 Kz	065111	RR Mon	200 7.0 Bl	T Pyx	249 6.4 Al
R Oct	229 10 7 Ch	071201	201 8.0 Sm	*090031*	252 7.5 Fd
055686	231 10.8 Pt	243 10.5 Lg	204 7.9 Ht	209 [u Bl	257 7.2 Fd
200 12.4 Bl	237 11.5 B	246 11.3 Lg	209 7.6 Ht	V UMa	259 6.6 Rt
202[12.0 Sm	247 12.2 Lg	V Gem	209 8.0 Bl	090151	263 6.8 Kz
S Lep	X Mon	071713	210 8.0 Sm	233 10.1 L	263 6.9 Eb
060124	*065208*	239 13.3 Pt	214 8.0 En	RW Car	Y Hya
238 6.8 By	229 8.0 Ch	242 13.1 B	T Gem	*091868*	*094622*
X Aur	239 9.4 Cb	247 13.6 Lg	074323	192 9.5 Bl	239 6.4 Pt
060450	241 8.4 Cb	S CMi	209 10.8 Ch	199 8.9 Bl	Z Vel
211 9.0 Ch	246 7.9 L	072708	223 11.2 Ch	210 8.6 Bl	*094953*
214 9.1 Ch	259 7.7 Rt	210 8.0 Ch	239 11.7 Pt	214 8.4 En	200 12.8 Bl
228 8.7 B	R Lyn	218 7.6 Ch	242 12.6 B	Y Vel	204[12.8 Ht
229 8.7 Ch	065355	232 7.4 Jo	U Pup	*092551*	209 12.8 Ht
231 8.4 Pt	229[11.9 Ch	234 7.1 Al	*075612*	200[12.9 Bl	V Leo
235 8.6 Ch	V CMi	236 8.5 Fd	241 12.2 GC	202[11.3 Sm	095421
242 8.0 Cl	070109	237 7.5 Jo	243 10.5 Lg	209 13.3 Bl	223 9.2 Ch
259 8.5 Rt	229 11.4 Ch	238 7.9 Fd	246 10.3 Lg	R Car	239 10.1 Pt
260 8.4 Kz	238 10.7 Lg	239 7.8 Cb		*092962*	
260 8.6 Eb	242 11.5 B	239 7.6 Pt		192 9.0 Bl	

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1928.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RV CAR	R CRV	R HYA	S APS	SX HER	S OCT
095563	*121418*	*132422*	*145971*	160325	*172486*
200[13.1 Bl	209 13.9 Bf	211 6.0 Ch	188 10.1 Sm	239 8.4 Pt	188 10.1 Ht
S CAR	215 13.9 Bf	239 6.0 Pt	190 10.0 Bl	248 8.7 Pt	190 9.7 Bl
100661	239 11.7 Pt	S VIR	198 10.0 Bl	250 8.4 Pt	198 9.7 Bl
192 6.4 Bl	T CVN	*132706*	201 10.2 Sm	RU HER	198 10.0 En
199 6.3 Bl	122532	022 7.6 Fu	209 10.2 Bl	160625a	198 10.0 Ht
202 5.5 Sm	218 11.7 Ch	023 7.7 Fu	Y LIB	248 14.1 Pt	201 10.0 Sm
204 5.8 Ht	239 10.9 Pt	030 7.3 Fu	*150605*	V OPH	204 10.0 Ht
209 5.5 Ht	Y VIR	033 7.5 Fu	248 8.8 Pt	*162112*	209 9.7 Bl
210 6.2 Bl.	*122803*	248 12.1 Pt	S CRB	248 9.9 Pt	209 10.0 Ht
214 5.5 En	209 13.9 Bf	RV CEN	151731	U HER	212 9.6 En
Z CAR	215 13.4 Bf	*133155*	211 7.2 Ch	162119	RU OPH
101058	U CEN	191 8.2 Bl	248 8.1 Pt	248 10.0 Pt	172809
192 10.7 Bl	*122854*	209 9.0 Bl	R NOR	SS HER	248 9.4 Pt
199 11.1 Bl	209 8.3 Bl	T CEN	*152849*	162807	RU SCO
202 11.1 Sm	T UMA	*133633*	188 9.9 Sm	248 9.4 Pt	*173543*
209 11.5 Bl	123160	209 6.1 Bl	191 8.5 Bl	W HER	191 8.9 Bl
W VEL	211 12.3 Ch	R CVN	198 8.6 Bl	163137	198 9.0 Bl
101153	239 13.0 Pt	134440	209 8.6 Bl	248 11.8 Pt	209 9.2 Bl
209 11.6 Bl	R VIR	248 11.2 Pt	S UMI	R DRA	SV SCO
R UMA	123307	T APS	153378	163266	*174135*
103769	239 8.1 Pt	*134677*	237 8.2 Jo	248 12.0 Pt	191 11.0 Bl
211 12.3 Ch	259 6.5 Rt	188 9.2 Sm	240 8.4 Jo	S HER	198 11.2 Bl
239 13.5 Pt	RS UMA	190 9.7 Bl	248 8.3 Pt	164715	209 10.5 Bl
V HYA	123459	198 10.4 Bl	259 8.3 Rt	248 8.1 Pt	W PAV
104620	209 13.3 Bf	202 10.0 Sm	T NOR	RS SCO	*174162*
209 8.0 Bl	215 13.2 Bf	209 10.7 Bl	*153654*	*164844*	196 13.0 En
218 8.7 Ch	232 10.5 Jo	R CEN	188 7.4 Ht	188 6.8 Sm	198[12.3 Ht
239 8.5 Pt	239 10.6 Pt	*140959*	188 7.5 Sm	191 6.9 Bl	200 13.0 Bl
RS HYA	240 10.3 Jo	191 5.8 Bl	R CRB	196 7.0 En	201[12.3 Sm
104628	241 11.4 Cb	198 6.7 Bl	154428	198 6.9 Bl	205[12.3 En
209[12.0 Bl	259 10.0 Rt	209 7.3 Bl	022 5.7 Fu	201 6.8 Sm	211[12.3 Ht
W LEO	S UMA	U UMI	023 5.6 Fu	209 7.1 Bl	U ARA
104814	123961	141567	030 5.6 Fu	RR SCO	*174551*
209 13.7 Bf	211 8.5 Ch	206 8.5 Wm	090 5.7 Fu	*165030*	188 8.4 Sm
215 13.8 Bf	232 9.0 Jo	217 8.6 Wm	118 5.7 Fu	057 6.4 Fu	196 8.0 En
S LEO	239 9.6 Pt	226 9.6 Wm	211 6.1 Ch	065 7.2 Fu	201 8.2 Sm
110506	240 9.8 Jo	239 9.3 Pt	231 6.1 Pt	080 7.3 Fu	205 8.0 En
239 12.5 Pt	241 10.2 Kl	S BOO	233 6.1 Pt	083 7.4 Fu	210 8.3 Sm
RY CAR	243 10.2 Kl	141954	236 6.6 Fd	089 7.5 Fu	213 8.2 En
111561	RU VIR	239 10.8 Pt	238 6.1 Pt	119 9.1 Fu	T DRA
209[13.1 Bl	124204	V BOO	239 6.1 Pt	191 11.1 Bl	175458a
RS CEN	239 11.6 Pt	142539a	241 6.2 Pt	196 11.7 En	231[12.5 GC
111661	U OCT	236 7.2 Fd	242 6.1 Sp	199 11.7 Bl	RY HER
192 9.2 Bl	*131283*	248 7.8 Pt	244 5.7 Fu	RV HER	175519
199 9.0 Bl	188 9.4 Sm	251 7.0 Gb	247 6.0 Sp	165631	214[11.0 Ch
209 9.2 Bl	188 9.2 Ht	259 8.3 Rt	248 6.1 Pt	241 9.6 Pt	231 11.5 Pt
X CEN	190 8.9 Bl	R BOO	249 6.1 Pt	RT SCO	V DRA
114441	198 8.1 Bl	143227	250 6.1 Pt	*165636*	175654
209[13.1 Bl	198 8.2 En	211 11.1 Ch	251 5.8 Gb	199[13.0 Bl	231 10.0 Pt
W CEN	198 8.6 Ht	248 8.7 Pt	R SER	RW SCO	R PAV
115058	201 8.2 Sm	251 8.0 Gb	154615	*170833*	*180363*
209 11.8 Bl	204 7.9 Ht	259 7.6 Rt	248 6.1 Pt	199[12.5 Bl	188 9.7 Ht
SU VIR	209 7.4 Ht	Y LUP	U SER	Z OPH	188 9.5 Sm
120012	209 8.2 Bl	*145254*	160210	171401	196 8.5 En
239 11.7 Pt	210 7.5 Sm	199[12.8 Bl	248 11.2 Pt	248 8.5 Pt	198 8.5 Ht
T VIR	212 7.5 En	S APS	SX HER	RS HER	201 8.3 Sm
120005		*145971*	160325	171723	202 8.5 En
239 13.6 Pt		190 10.0 Bl	233 8.3 Pt	231 10.4 Pt	204 8.1 Ht

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1928.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R PAV	R CRA	RY SGR	RT CYG	S TEL	RS CYG
180363	*185537a*	*191033*	194048	*195855*	200938
205 8.1 En	191 12.2 Bl	201 7.0 Sm	231 8.9 Pt	200 13.3 Bl	218 7.3 Ch
209 7.9 Ht	199 12.1 Bl	204 6.7 Ht	232 8.8 Jo	SY AQL	220 7.2 Ch
210 8.0 Sm	200 12.8 Bl	204 6.6 Bf	237 8.9 Jo	200212	226 7.2 Ch
213 8.0 En	210[12.5 Bl	205 7.0 En	237 9.4 Cb	231 9.8 Pt	229 7.4 Ch
	T CRA	209 6.5 Ht	240 9.0 Jo	232 9.8 Lg	231 7.3 Pt
T HER	*185537b*	210 6.5 Sm	263 11.1 Eb	234 9.6 L	232 7.5 Ch
180531	200 13.5 Bl	210 6.0 Bl	263 11.1 Kz	238 9.8 Lg	232 7.5 Jo
210 8.9 Ch	RT LYR	212 6.5 En	TU CYG	S CYG	233 7.2 Al
231 11.2 Pt	185737	212 6.2 Bf	194348	200357	234 7.7 L
234 11.5 L	214 10.5 Ch	TV SGR	209 11.3 Ch	226[11.7 Ch	235 7.5 Ch
	226 10.3 Ch	*191124*	220 10.6 Ch	R CAP	237 7.7 Jo
TV HER	V AQL	200[12.4 Bl	226 10.5 Ch	*200514*	237 8.4 Cb
181031	*185905*	S SGR	231 10.2 Pt	212 9.7 Ch	240 8.0 Jo
234 13.4 L	214 6.8 Ch	*191319a*	263 11.1 Kz	231 10.9 Pt	242 7.8 Sp
	R AQL	200 13.0 Bl	263 11.0 Eb	SV CYG	249 7.5 Al
RY OPH	190108	210 12.4 Bl	X AQL	200647	257 8.9 Bh
181103	212 9.8 Ch	SW SGR	194604	225 9.0 Rt	R DEL
231 8.7 Pt	231 9.8 Pt	*191331*	228 10.1 B	227 8.9 Rt	201008
	RX SGR	200[12.9 Bl	231 10.5 Pt	229 9.6 By	209 8.5 Ch
RV SGR	*190818*	TZ CYG	χ CYG	232 9.5 Rt	228 8.8 B
182133	212[10.8 Ch	191350	194632	232 9.3 Wo	231 8.5 Pt
191 9.0 Bl	RW SGR	231 10.3 Pt	226 13.1 Ch	233 9.6 By	234 8.3 L
199 9.3 Bl	*190819a*	263 10.5 Sp	231 12.9 Pt	239 9.5 By	SX CYG
210 9.9 Bl	212 10.0 Ch	U LYR	RR SGR	239 9.3 Rt	201130
	S LYR	191637	*194929*	S AQL	231 9.2 Pt
SV HER	190925	231 8.3 Pt	191 11.0 Bl	200715a	RT SGR
182224	214[11.6 Ch	TY CYG	199 11.4 Bl	209 9.8 Ch	*201139*
234[13.3 L	X LYR	192928	210 11.8 Bl	231 9.8 Pt	200 11.1 Bl
X OPH	190926	220[11.9 Ch	RU SGR	232 10.2 Lg	210 10.9 Bl
183308	231 9.0 Pt	RT AQL	*195142*	235 9.6 Ch	WX CYG
234 7.8 L	RS LYR	193311	188 11.0 Ht	238 9.8 Lg	201437b
	190933a	231 8.2 Pt	188 11.1 Sm	RW AQL	209 10.9 Ch
R SCT	214 11.2 Ch	R CYG	191 11.0 Bl	200715b	220 10.7 Ch
184205	226 11.5 Ch	193449	196 11.1 En	231 9.1 Pt	226 10.6 Ch
208 5.9 Ch	231 11.7 Pt	231 12.2 Pt	198 11.3 Ht	232 9.1 Lg	228 10.5 B
212 5.8 Ch	RU LYR	231 12.2 GC	199 11.0 Bl	238 8.9 Lg	231 10.5 Pt
218 5.8 Ch	190941	235 12.0 Pn	201 11.6 Sm	R TEL	232 10.8 Jo
231 5.5 Pt	231 10.7 Pt	237 12.0 Cb	204 11.8 Ht	*200747*	234 10.9 L
231 5.8 Lg	U DRA	263 10.4 Eb	205 12.1 En	191 10.0 Bl	237 11.1 Cb
232 5.6 Lg	190967	263 10.2 Kz	209 12.0 Ht	199 10.0 Bl	237 10.5 Jo
232 5.6 Pt	226 11.3 Ch	RV AQL	210 12.5 Sm	210 10.5 Bl	240 10.2 Jo
233 5.6 L	231 11.0 Pt	193509	210 11.8 Bl	RU AQL	U CYG
234 5.5 Lg	240 11.1 Ie	231 14.0 Pt	212 12.3 En	200812	201647
234 5.2 Pt	T SGR	T PAV	RR AQL	229 12.5 B	220 11.1 Ch
236 5.5 Pt	*191017*	*193972*	*195202*	W CAP	228 9.9 B
238 5.3 Pt	212 9.9 Ch	188 13.0 Sm	231 10.9 Pt	*200822*	229 10.8 By
NOV AQL	R SGR	198 12.1 Ht	NOV CYG	200[12.8 Bl	231 9.5 Pt
184300	*191019*	200 11.8 Bl	195553	Z AQL	233 9.5 Al
214 10.3 Ch	212[11.2 Ch	201 11.5 Sm	229[12.2 Pt	*200906*	233 10.9 By
234 10.8 Pt	RY SGR	204 11.9 Ht	232[11.5 Ch	192 13.0 Bg	237 10.6 Cb
RX LYR	*191033*	209 11.2 Ht	234[12.2 Pt	203 11.7 Bf	237 9.7 Jo
185032	188 6.5 Ht	210 11.0 Sm	256[12.2 Pt	207 11.4 Bg	239 10.8 By
231 12.9 Pt	188 6.5 Sm	210 11.3 Bl	Z CYG	212 10.1 Bg	240 9.6 Jo
S CRA	191 6.3 Bl	RT CYG	195849	231 9.5 Pt	242 11.0 Sp
185437a	196 7.0 En	194048	231 12.7 Pt	RS CYG	263 10.1 Sp
191 11.7 Bl	198 6.9 En	209 8.1 Ch	263 9.3 Kz	200938	U MIC
199 11.4 Bl	198 6.9 Ht	220 8.5 Ch	263 9.4 Eb	209 7.2 Ch	*202240*
210 11.5 Bl	199 6.5 Bl	226 8.9 Ch		214 7.2 Ch	191 10.1 Bl

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1928.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
U MIC	Y AQR	X CEP	S MIC	RY PEG	T TUC
202240	*203905*	210382	*212030*	220133a	*223462*
199 10.7 Bl	192 10.1 Bg	239 13.1 GC	210 9.0 Bl	229 13.0 B	188 8.9 Ht
210 11.2 Bl	203 9.7 Bf	RS AQR	Y CAP	RZ PEG	197 9.1 En
RW CYG	207 10.9 Bg	*210504*	*212814*	220133b	198 9.3 Ht
202539	212 11.2 Bg	231 10.5 Pt	200[12.9 Bl	229 10.6 B	201 9.0 Sm
225 8.1 Rt	231 11.9 Pt	236 10.7 L	210[12.9 Bl	236 10.5 Pt	204 9.8 Ht
227 8.1 Rt	232 12.1 Lg	242 10.8 GC	235[10.6 Ch	T PEG	206 10.1 En
232 8.4 Rt	238 12.3 Lg	Z CAP	W CYG	220412	209 10.2 Ht
232 8.5 Wo	T DEL	*210516*	213244	237 12.7 GC	213 10.2 En
239 8.4 Rt	204016	207 14.5 Bg	208 6.4 Fu	242 12 9 B	215 9.9 Sm
RU CAP	222[11.6 Ch	212 14.4 Bg	209 6.6 Fu	Y PEG	R LAC
202622	229[13.6 B	R EQU	216 6.4 Fu	220613	223841
192[14.5 Bg	V AQR	210812	233 6.5 L	192 14.1 Bg	213[11.6 Ch
203 14.9 Bf	204102	206 10 8 Bg	235 6.5 Fu	201 12.7 Bg	223[13.6 GC
207 15.2 Bg	231 8.9 Pt	212 10.0 Bg	242 6.4 Fu	206 12.4 Bg	234[13.7 GC
212[14.7 Bg	235 8.8 Ch	229 9.5 B	243 6.5 Fu	212 11.8 Bg	241[10.1 Cl
Z DEL	W AQR	T CEP	244 6 4 Fu	227 9.8 B	U LAC
202817	*204104*	210868	245 6.5 Fu	236 11.5 Pt	224354
228 10.6 B	192 13.1 Bg	208 8.1 Fu	S CEP	RS PEG	229 8 4 By
231 10.4 Pt	203 13.6 Bf	209 8.4 Fu	213678	220714	238 8.5 By
240 10.1 Ie	207 13.5 Bg	209 8.0 Ch	227 8.9 B	192 13.6 Bg	RW PEG
SZ CYG	212 13.2 Bg	216 8.6 Fu	230 9.0 Ch	201 13.5 Bg	225914
202946	236 12.3 L	217 8.4 Fu	231 8.0 Pt	206 13.3 Bg	201 11.9 Bg
229 9.3 Pt	U CAP	227 8.0 B	232 8.5 Jo	212 13.2 Bg	206 11.8 Bg
231 9.6 Pt	*204215*	229 8.3 Ch	240 8.3 Jo	227 12.5 B	212 11.5 Bg
232 9.4 Pt	200[13.6 Bl	231 8.0 Pt	RU CYG	X AGR	240 10.4 GC
233 9.2 Pt	T AQR	231 8.7 Wm	213753	*221321*	242 10.3 Sp
234 8.8 Pt	*204405*	232 7.8 Jo	211 9.0 Ch	192 8.9 Bg	242 10.2 B
236 8.5 Pt	231 9.5 Pt	235 8.6 Fu	236 8.5 Pt	203 9.0 Bf	263 9.9 Sp
237 8.8 Pt	232 9.8 Lg	236 8.5 Fd	RV CYG	207 9.2 Bg	R PEG
238 8.8 Pt	235 10.0 Ch	237 8.3 Gy	213937	212 9.1 Bg	230110
239 8.8 Pt	238 9.8 Lg	237 8 0 Jo	229 7.0 By	T GRU	213 12.2 Ch
241 9.0 Pt	RZ CYG	239 8.7 Gy	234 6.9 L	*221938*	229 12.8 Sf
242 9.4 Pt	204846	240 8.3 Jo	236 6.5 Pt	196 10.6 En	231 13.4 Lg
244 9.7 Pt	231 11.6 GC	241 9.1 Fd	238 6.8 By	201 10.3 Sm	236 12.8 Pt
248 8.9 Pt	231 11.8 Pt	242 8.7 Fu	RR PEG	202 10.8 En	V CAS
249 9.0 Pt	244 11.8 B	243 8.7 Fu	214024	205 11.0 En	230759
252 8.8 Pt	S IND	244 8.8 Fu	227 9.9 B	210 10.3 Sm	227 11.7 B
256 9.0 Pt	*204954*	257 9.6 Fd	236 9.0 Pt	212 11.0 En	236 11.7 Pt
ST CYG	200[13 5 Bl	263 8.8 Pn	241 8.9 Cl	S GRU	244 12.0 B
202954	X DEL	RR AQR	R GRU	*221948*	W PEG
228 13.2 B	205017	*210903*	*214247*	198[12.8 Ht	231425
231 13 3 Pt	229 10.0 B	231 13.4 Pt	196 13.2 En	201[12.8 Sm	213 9 5 Ch
V DEL	231 9.9 Pt	X PEG	200 13.5 Bl	205[12.8 En	237 10.8 Jo
203226	R VUL	211614	210[12.9 Sm	209[12.8 Ht	240 10.7 Jo
231 9.1 Pt	205923	228 12.0 B	204[12.9 Ht	212[12.8 En	241 11.0 Kl
R MIC	222 7.5 Ch	231 11.8 Pt	V PEG	RV PEG	249 11.0 Lg
203429	231 7.8 Pt	T CAP	215605	222129	S PEG
191 12.0 Bl	V CAP	*211615*	229 12.0 B	229 9.5 B	231508
200 13.3 Bl	*210124*	191 11.7 Bl	236 11.7 Pt	263 9.7 Sp	213 10.8 Ch
S DEL	191 9.5 Bl	199 11.5 Bl	U AQR	S LAC	227 11.4 B
203816	199 9.6 Bl	210 9.8 Bl	*215717*	222439	236 11.6 Pt
228 11.8 B	210 9.6 Bl	235 9.1 Ch	232 11.2 GC	227 13.2 B	256 12.4 B
231 11.8 Pt	X CAP	S MIC	236 11.6 Pt	236 12.9 L	V PHE
V CYG	*210221*	*212030*	RT PEG	236 13 0 Pt	*232746*
203847	200 12.6 Bl	191 9 6 Bl	215934	R IND	188 10.8 Ht
229 13.7 B	210 11.7 Bl	199 9.3 Bl	213[11.4 Ch	*222867*	196 10.5 En
231 13.4 Pt		201 9.3 Sm	229 11.0 B	191 11.3 Bl	198 11.8 Ht
		210 8.9 Sm		199 12.0 Bl	201 12.0 Sm

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1928.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V PHE	ST AND	R AQR	R AQR	V CET	R CAS
232746	233335	*233815*	*233815*	*235209*	235350
202 12.0 En	231 11.0 Lg	199 9.9 Bl	236 10.0 L	192 11.5 Bl	244 9.1 B
204 12.2 Ht	232 10.6 Ch	202 10.3 Sm	238 10.6 GC	199 11.1 Bl	Z PEG
205 12.5 En	234 10.5 Al	204 10.2 Ht	263 9.7 Sp	210 10.0 Bl	235525
209 12.7 Ht	236 10.6 Pt	204 10.2 Bf	RS AND	238 8.6 L	236 12.3 Pt
212 12.5 En	238 11.0 Lg	209 10.4 Ht	235048	R TUC	Y CAS
Z AND	244 11.2 Lg	210 10.3 Bl	229 9.7 By	*235265*	235855
232848	249 11.5 Lg	212 10.1 En	238 9.5 By	197 12.0 En	227 10.7 B
213 8.8 Ch	R AQR	212 10.3 Bf	RR CAS	201 12.2 Sm	244 10.9 B
236 10.4 Pt	*233815*	213 10.1 Ch	235053	206 12.7 En	SV AND
ST AND	188 9.9 Ht	223 10.7 GC	227 10.5 B	212 12.9 En	235939
233335	192 9.5 Bl	232 10.1 Lg	242 11.2 Ie	R CAS	229 10.5 B
213 10.6 Ch	197 9.8 En	235 10.0 Ch	244 11.3 B	235350	236 10.9 Pt
229 10.1 B	198 10.1 Ht	236 9.9 Pt	257 11.6 Bn	227 9.0 B	242 11.2 Ie

RAPIDLY VARYING IRREGULAR VARIABLES.

Star J.D. Est.Obs.	J.D. Est.Obs.	Star J.D. Est.Obs.	J.D. Est.Obs.
005840 RX ANDROMEDAE—		074922 U GEMINORUM—	
5229.6 11.5 Pt	5241.6 11.5 Pt	5238.7 13.8 Lg	5247.9 13.9 Lg
5231.7 12.4 Pt	5242.7 11.9 Pt	5239.6[13.7 GC	5249.7[13.3 **Lg**
5232.6 12.4 Pt	5244.7[11.9 Pt	5240.6[13.3 Ie	5256.6[13.8 B
5233.6[11.7 Pt	5248.7[11.7 Pt	5241.7[12.4 Pt	5257.6[13.8 B
5234.6 13.3 Pt	5249.6[11.3 Pt	5242.6[13.3 GC	5258.6[12.4 Bh
5236.6[12.4 Pt	5252.7[11.5 Pt	5243.7[13.7 Lg	5260.6[12.4 Bh
5238.6 11.7 Pt	5256.7[12.4 Pt	5244.7[13.7 B	5261.6[11.7 Bh
5239.6 10.9 Pt		5246.8[13.7 Lg	5263.7[11.0 **Sp**
060547 SS AURIGAE—		213843 SS CYGNI—	
5209.4 14.7 Bf	5237.5 13.5 B	5208.2 10.0 Ch	5233.0 **8.4 Ch**
5215.4 14.6 Bf	5238.7 13.7 Lg	5209.1 10.4 Ch	5233.4 8.6 L
5228.3 11.9 L	5239.6[12.6 Pt	5210.2 10.9 Ch	5233.5 9.5 Al
5228.6 11.9 B	5240.6[13.3 Ie	5211.2 11.6 Ch	5233.5 8.8 GC
5229.1 11.6 Ch	5241.5[13.5 Cl	5212.1 11.6 Ch	5233.6 8.8 By
5229.5 11.2 Cl	5242.7[**12.4 Pt**	5213.1 11.6 Ch	5233.6 9.0 Pt
5229.6 11.3 B	5243.7[13.3 Lg	5214.1 11.6 Ch	5234.3 8.6 L
5229.7 10.9 Pt	5244.7[13.3 Lg	5215.2 11.6 Ch	5234.5 9.2 Al
5230.1 11.1 Ch	5246.7[13.3 Lg	5220.1 11.6 Ch	5234.5 8.8 GC
5231.1 11.1 Ch	5247.7[13.7 Lg	5220.6 12.0 GC	5234.6 9.0 Pt
5231.7 11.0 Pt	5248.7[12.4 Pt	5222.1 11.8 Ch	5235.5 **9.1 Pn**
5232.1 11.2 Ch	5249.7[13.3 Lg	5223.6 11.8 GC	5235.6 9.0 B
5232.6 11.5 Pt	5250.9[12.4 Pt	5225.2 11.9 L	5236.2 9.0 L
5233.2 11.6 Ch	5252.7[12.4 Pt	5226.1 11.2 Ch	5236.5 9.2 Al
5233.2 11.0 L	5256.6[12.4 Bh	5227.6 11.5 B	5236.6 9.1 Fd
5234.2 11.8 Ch	5257.6[12.4 Bh	5228.3 11.9 L	5236.6 8.8 Cl
4234.3 11.1 L	5258.6[12.4 Bh	5228.6 11.8 B	5236.6 9.1 Pt
4235.5 12.4 B	5260.9[12.4 Eb	5229.1 11.6 Ch	5237.5 9.5 GC
5236.3 12.4 L	5261.6[12.4 Bh	5229.5 **11.6 Cl**	5237.5 **9.3 B**
5236.6 **12.7 Cl**		5229.6 12.0 By	5237.6 9.2 Pt
074922 U GEMINORUM—		5229.6 11.7 B	5238.5 9.7 By
5208.2[12.3 Ch	5223.2[12.4 Ch	5229.7 11.7 Pt	5238.6 9.6 GC
5209.4 14.1 Bf	5228.6[13.7 B	5230.1 11.9 Ch	5238.6 9.3 Pt
5211.2[12.3 Ch	5229.7[13.8 GC	5231.1 11.8 Ch	5238.6 9.6 Fd
5213.2[12.3 Ch	5231.7[12.4 Pt	5231.5 11.2 GC	5238.7 9.3 Kn
5214.2[12.4 Ch	5232.6[13.3 GC	5231.6 11.4 Pt	5238.7 9.3 Lg
5215.4 14.1 Bf	5233.6[13.3 GC	5232.0 10.0 Ch	5239.5 10.1 By
5216.2[12.4 Ch	5234.2[12.4 Ch	5232.5 9.3 GC	5239.5 9.8 GC
5218.2[10.9 Ch	5235.2[12.4 Ch	5232.6 9.3 By	5239.6 9.6 Pt
5220.7[13.3 GC	5236.6[12.4 Pt	5232.6 9.0 Pt	5240.5 10.6 GC

VARIABLE STAR OBSERVATIONS RECEIVED DURING JANUARY, 1928.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
213843 SS CYGNI—							213843 SS CYGNI—						
	5240.6	10.0	Jo	5242.5	11.1	GC		5247.7	11.9	Lg	5256.7	11.7	Pt
	5241.2	10.6	Kl	5242.6	11.2	B		5248.7	11.7	Pt	5257.6	11.6	Bh
	5241.5	10.7	Cl	5242.6	11.5	Pt		5249.6	11.7	Pt	5258.6	11.9	Bh
	5241.5	10.7	GC	5243.2	11.1	Kl		5249.7	12.1	Lg	5260.6	11.8	Bh
	5241.5	10.8	Pn	5243.7	11.1	Lg		5250.5	11.7	Pn	5261.6	11.9	Bh
	5241.6	10.8	B	5243.7	11.1	Kn		5253.5	11.9	Eb	5263.4	11.9	Pn
	5241.6	11.4	Pt	5244.6	11.4	B		5253.5	11.9	Kz	5263.5	11.5	Sp
	5242.2	10.8	Kl	5244.7	10.7	Lg		5256.6	11.6	B	5263.5	12.0	Kz
	5242.5	11.1	Cl	5244.7	11.7	Pt		5256.6	11.7	Bh	5263.5	12.0	Eb
	5242.5	11.1	Sp	5246.7	11.9	Lg		5252.6	11.7	Pt			

MONTHLY SUMMARY.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Allen	Al	13	22	Houghton	Ht	29	92
Baldwin	Bl	84	182	Iedema	Ie	16	16
Bappu	Bf	20	32	Jones	Jo	24	54
Barry	By	14	26	Kendall	Kn	3	4
Bhaskaran	Bg	14	40	Kohl	Kl	4	8
Bouton	B	89	119	Kurtz	Kz	47	51
Brown	Bn	3	3	Lacchini	L	32	39
Bunch	Bh	8	23	Logan	Lg	33	75
Chandra	Ch	108	172	Peltier	Pt	175	286
Cherrington	Cb	10	11	Prentice	Pn	6	16
Clement	Cl	8	12	Rittenberg	Rt	18	22
Ebert	Eb	47	51	Smith, W. H.	Sm	45	77
Ensor	En	40	96	Smith, F. W.	Sf	1	1
Ford	Fd	11	28	Spears	Sp	14	20
Furuhata	Fu	7	49	Williams	Wm	3	8
Gaebler	Gb	5	5	Wolff	Wo	2	2
Goodsell	GS	2	2	Georgetown	GC	21	42
Gregory	Gy	4	4	Coll. Obs.	—		
				Totals	35	344	1670

LEON CAMPBELL, Recording Secretary.

February 8, 1928.

COMET NOTES.

By G. VAN BIESBROECK.

COMET 1928 *a* (REINMUTH). The first new comet of the year has just been reported from the Heidelberg Observatory on February 24:

Comet Reinmuth. Magnitude 12.

Feb. 22.9616 $9^h\ 15^m\ 04^s$ $+21°\ 44'$

Daily motion: -10^s and $6'$.

The object has evidently been found on plates taken in the course of the work on asteroids which is being carried on so successfully at Heidelberg under the energetic direction of Professor Max Wolf. Seen through the 40-inch refractor on the night of February 24, the comet appeared to the writer as a nearly round

nebulous coma, about 1′ in diameter, with a well defined nucleus. I measured the position as follows:

Feb. 25.07288 $9^h\ 14^m\ 42^s.44$ $+22°\ 0'\ 46''.4$

which confirms the slow northwesterly motion. The position falls on the boundary of the constellations of Cancer and Leo. I estimated the total brightness as $12^M.5$ so that the observation requires at present a good-sized telescope.

We have to await further measures for learning something about the future development of this apparently remote new visitor.

During the last month two more supposedly new comets have been announced. On January 27 the Cracow Observatory asked for confirmation of the presence of a cometary object near δ Piscium, which had been noticed by Wilk, the discoverer of comet 1925 *k*. The same night the writer examined the region concerned and could not find anything there but comet Encke, close to the position assigned by the ephemeris. No other information having been received on the subject it is evident that the Polish observer was not aware of the identity of the long known comet.

A week later a good many hours were wasted here both by Professor Ross and the writer, getting plates and laboriously searching these in another futile hunt. A telegram broadcast on February 3 by the Algiers Observatory was worded as follows:

Comet Filippoff Jan. 28.9625 $6^h\ 24^m\ 56^s$ $+20°\ 16'$ Magn. 11.
Daily motion slight.

Images much fainter than 11^M were recorded on our plates and no trace could be found of anything corresponding to the description. On February 7 the cause of our failure was explained when a second telegram was received stating that the supposed comet was a spurious image. We might express the pious wish that more caution would be observed in announcing discoveries!

During the past month Comet 1927 *h* (Periodic Encke) has been lost from sight through its conjunction with the sun. A last glimpse was obtained here on February 12 shortly after sunset, when the comet was seen at a low altitude near the western horizon as a nebulous object as bright as 8^M.

Comet 1927 *k* (Skjellerup) is now coming into reach of southern observatories as far as the angular separation from the sun is concerned, but it is already so remote that probably very little is left of what proved to be the brightest comet visible since the beginning of this century. Numerous reports from observers in the southern hemisphere, having independently seen the comet about the time of its discovery, have been published: in New Zealand, in India, in Argentina, etc., some as early as November 30, four days before Skjellerup determined the first position.

In the morning sky Comet 1927 *g* (Periodic Schaumasse) is now too faint for further observations. It was last photographed here on January 22, so that the duration of visibility has been four months.

Another attempt was made here to record Comet 1926 *f* (Comas Solá), but the object could not be found on the plates although these reach down to 16^M.

Comet 1927 *d* (Stearns) has nearly completed its first year of visibility. Seen in the 40-inch refractor it appeared on February 16 and 20 as a nearly stellar nucleus surrounded by a coma about 40″ in diameter. The coma is brightest and

mostly extended in the first quadrant, giving the object a dissymetrical appearance; but the extension can hardly be called a tail. The integrated brightness corresponded to a magnitude of 13 on the latter date. It is now evident that this object will be in reach of larger instruments for a good many months to come.

I computed the following ephemeris from Crommelin's elements (*Copenhagen Circ.* 185) deduced from measures up to 1927 September 21:

$$\left.\begin{aligned} T &= 1927\ \text{March}\ 22.5420\ \text{U.T.} \\ \omega &= 11^\circ\ 5'\ 58''.8 \\ \Omega &= 214\ 36\ 24.1 \\ i &= 87\ 35\ 28.8 \end{aligned}\right\} 1927.0$$

$$\phi = 83\ 10\ 2.9$$

$$\text{Log. } q = 0.565918$$

$$\text{Log. } a = 2.714550$$

EPHEMERIS OF COMET 1927 *d* (STEARNS) FOR 0^h U.T.

1928	h m	° ′	M
March 1	17 28.3	+47 23	13.0
9	33.6	49 38	
17	37.9	51 53	
25	41.1	54 7	
April 2	43.0	56 15	
10	43.4	58 21	
18	42.2	60 18	
26	17 39.3	+62 6	13.2

From the constellation of Hercules the comet passes into Draco and becomes more and more circumpolar, while its theoretical brightness diminishes by only $0^M.1$ per month.

COMET 1927 *j* (SCHWASSMANN-WACHMANN) has now become extremely faint. On plates secured by the writer on February 12, 13, and 21 with the 24-inch reflector, it appears as a tiny object, so small that it is difficult to distinguish from faint stars. The enormous decrease in brightness since last November is hard to account for. When first observed the magnitude was given as 13 to 14; in February the magnitude was roughly evaluated here as 17. and careful comparisons would tend to make it even fainter. The images obtained with exposures of one hour in February are very much weaker than those resulting from exposures of 10 minutes in November. Yet the theoretical brightness has changed by less than a magnitude between these dates.

The exact form of the orbit described by this very distant comet is still quite uncertain. A new orbit has been computed at Berkeley by L. Berman and F. L. Whipple from observations on November 18, December 15, and January 21, with the result:

$$\left.\begin{aligned} T &= 1925\ \text{May}\ 15.040\ \text{U.T.} \\ \omega &= 0^\circ\ 23'\ 42''.9 \\ \Omega &= 322\ 40\ 45.4 \\ i &= 9\ 25\ 47.4 \end{aligned}\right\} 1928.0$$

$$e = 0.142208$$

$$a = 6.42840 \text{ astr. units}$$

$$q = 5.51423$$

$$P = 16.299 \text{ years}$$

If we compare these with L. E. Cunningham's orbit (see p. 119) we see that the eccentricity has been greatly reduced and the period shortened by one year. Figure 1 illustrates the result of the computation with the longer arc. This time the orbit of the comet is situated entirely between Jupiter and Saturn and its

distance from the sun changes much less than in the diagram given on page 120. The positions of the comet and the two planets for the beginning of the successive years 1925 to 1930 are marked on their respective orbits, and the two crosses on the orbit of the comet indicate its position on the extreme dates used in the com-

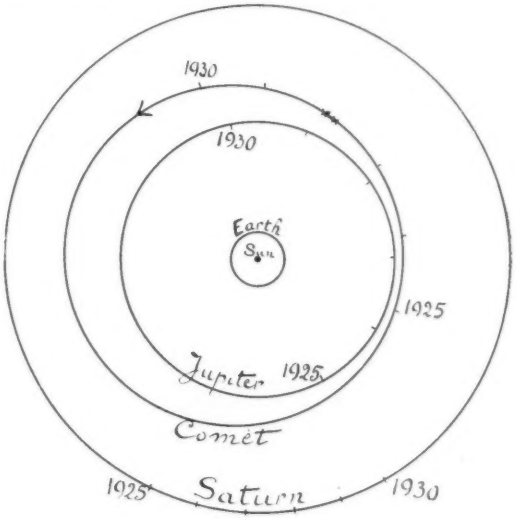


FIGURE 1.
ORBIT OF COMET 1927 *j* ACCORDING TO BERKELEY ELEMENTS.

putation. It is not surprising that the orbit is hard to determine from the small arc described in two months. Another month has been added since then to the period during which it has been observed. As the comet moves into the evening sky and requires longer and longer exposures in order to be recorded it is doubtful if it will be possible to follow it in March. But the results obtained so far would seem sufficient for predicting the position at the next opposition.

Williams Bay, Wisconsin, February 23, 1928.

GENERAL NOTES.

A Request. — We wish to reiterate here the statement published in the issue for November of last year, with one addition. It was stated there that our files of the issues of January, May, and August-September (1927) were nearly exhausted. Several copies of these issues, although not so many as we should like, were received in reply to our request. We now, because of continued calls for back copies, must add March (1927) to the list. We shall gladly purchase copies of any of these four issues on the basis already mentioned, namely, to remit fifty cents a copy, or, if preferred, to extend subscriptions for two issues. ED.

Dr. Dayton C. Miller, professor of physics in the Case School of Applied Science, addressed the Washington Academy of Sciences, February 16, on "Photographing and Analyzing Sound Waves." (*Science,* February 17, 1928.)

Dr. W. J. Humphreys, of the U. S. Weather Bureau, gave an illustrated lecture on "Clouds and Cloud Splendors" to the Sigma Xi of the University of Kentucky, on January 19. (*Science,* February 3, 1928.)

Professor E. W. Brown, professor of mathematics in Yale University, has been elected an associate of the Royal Academy of Belgium. M. Armand Renier, director of the geological sciences of Belgium, and Professor Lucien Hauman, professor of botany in the University of Brussels, have been elected *correspondents* of the academy. (*Science,* February 3, 1928.)

Dr. R. T. A. Innes, for many years Union Astronomer at Johannesburg, South Africa, retired on account of age on January 1, 1928. Mr. H. E. Wood, who has been Chief Assistant, succeeds him as Union Astronomer. Dr. W. H. van den Bos, who has during the past two years been doing notable work with the Union telescope on southern double stars as a visiting astronomer from the Leiden Observatory, has been appointed Acting Chief Assistant in succession to Mr. Wood.

Dr. H. A. Lorentz, professor of physics in the University of Leiden since 1878, died on February 5, at the age of seventy-four years. Dr. Lorentz was very well known in this country, having been called frequently to deliver lectures on the physical sciences in which he was an acknowledged authority.

Mrs. Frank Schlesinger died at her home in New Haven on January 25 after an illness of several years' duration.

The Gold Medal of the Royal Astronomical Society has been awarded to Professor R. A. Sampson, astronomer-royal for Scotland, for his theory of the four great satellites of Jupiter, to Jackson-Gwilt Stevenson for his work on faint variable stars and Herschel instruments, and to W. Reid, of Cape Town, for his discovery of six new comets. (*Science,* February 3, 1928.)

Prizes in Astronomy Awarded by the Paris Academy of Sciences.—At the annual meeting of the Academy the following prizes awarded in 1927 were announced: The Lalande Prize to Vincent Nechville, for his researches on star streams; the Valz Prize to Lucien d'Azambuja, for his work on sunspots, the solar prominences, and chromosphere; the De Pontécoulant Prize to Emile Paloque, for his work on the analytical theory of the movement of the Trojan planets. (*Nature,* January 14 ,1928.)

A Planetarium for Moscow.—The city of Moscow has appropriated $150,000 for a planetarium to demonstrate to the people how the solar system functions. This planetarium, identical with the one in Berlin, has been ordered from the Zeiss Optical Company, Jena. (*Science,* February 3, 1928.)

The Southern Cross Observatory at Miami, Florida, is again having a very successful season. Early in February a new record for the observatory was established by entertaining 2500 people in one evening. No doubt this is a record not only for this observatory but for all observatories. It is to be remem-

bered that the dome of this observatory is the sky itself, and consequently sufficiently spacious for the constantly increasing crowds.

Sunspots and Radio Reception. — Professor H. T. Stetson writes that installation has been made of a new set of apparatus at the Harvard Astronomical Laboratory to be used for the study of the dependence of radio reception upon sunspots. The apparatus has been designed and placed in the Laboratory by Mr. Greenleaf W. Pickard of the Wireless Specialty Company and is to be used in coöperation with Mr. Pickard's researches on the correlation of radio reception and solar phenomena. The results already obtained in Mr. Pickard's private laboratory during the last two years have indicated that night reception is invariably impaired with the passing of sunspots across the sun's surface. The observations at the Astronomical Laboratory have already begun and will be continued nightly throughout the continuance of the present sunspot maximum. The Laboratory is coöperating with the Yerkes, Mount Wilson, and Naval Observatories in furnishing the solar data now being published in the "Weather Review."

Mount Lowe Observatory Damaged by Wind.—In a clipping from the *Los Angeles Times* for February 10, 1928, we have the following information concerning the damage which resulted from a high wind storm, on the morning of February 9: "A fifty-mile gale swept Mt. Lowe at 6:00 A.M., snatched the dome roof from the observatory and hurled it 2000 feet down the mountain side, where it lodged in a clump of trees. The wind also damaged the remainder of the structure, which comprised an observing room, a lecture room and living quarters. No one was in the building at the time, the damage being discovered early yesterday morning by the Pacific Electric dispatcher at Echo Mountain.

"When the dome went off the tube of the telescope fell over and was badly damaged, but the 16-inch lenses were stored away and not damaged. Mt. Lowe Tavern, farther up the mountain, and the railroad leading to it were not damaged according to Pacific Electric officials.

"The Mt. Lowe telescope was installed in 1894 by Prof. Thaddeus S. C. Lowe, who conceived and built the incline railway. Since then it has been modernized from time to time and is one of the few 16-inch objective equatorial telescopes available to the public. Many noted scientists have made use of this telescope. The present observer is C. F. Lawrence.

"A severe wind storm was reported from Mt. Wilson, but no damage was reported."

HEAVENLY ZOO.

Canes Venatici.

Boötes drives this doggy pair
Around the north pole, chasing Bear,
And Chara is the name of one:
They leap the whirlpool nebula
And circle a vast area:
The other is Asterion.

1490 Stuart St., Denver, Colorado. LILIAN WHITE SPENCER.

The Reform of the Calendar.

Since any discussion under the above topic is of interest because it relates to the daily life of everyone, it was thought desirable to give those of our readers, who may not be familiar with the French language, the benefit of some comments signed E. L. and published in "Ciel et Terre" for January, 1927, p. 21. The translation is by Merten Hasse, while a student in Carleton College. ED.

It is known that the problem of the reform of the Gregorian calendar has been taken up by the League of Nations. The Association of Academies and the International Astronomical Union are no longer interested on the basis that this problem is not at all scientific, but only of a utilitarian character. We hope that this does not signify that, in the minds of astronomers, science is merely a jewel and that usefulness is not a part of its domain.

Be that as it may, a special research committee has been appointed by the council of the League of Nations, and this committee will have a serious task to accomplish if it wishes conscientiously to carry out the commission. It seems, moreover, that it will be able to simplify matters very much by discarding at the start all systems which do not include the preservation of the week and the twelve months; there will still remain a sufficient number of good plans.

M. Grablovitz,[1] the director of the seismographic station at Ischia, makes some observations on the subject, under the title: "La Riforma del Calendario alla Società della Nazioni," and in stating his comments we shall add some of our own.

He recalls that the first plan is the one proposed by Mr. Marvin, the director of the meteorological service of the United States: thirteen months of four weeks and one supplementary day, or two days in leap years to end the year; these would be the days of "Humanity." M. Grablovitz notes that this plan is identical with the one proposed in 1900 in "Astrofilo," by M. Gentile Pagani, the director of the historical archives in Milan.

A second plan places one or two extra days at the beginning of the year, the 364 remaining days giving four three-month periods of 91 days or 13 weeks each. Thus the year is one of 12 months.

This latter plan is identical with the one conceived by Flammarion and supported by him throughout his long career both as a professional astronomer and a popularizer of the science. It also is known under the name of the "Armelin plan," and was adopted as the best, in 1887, by the committee of the Astronomical Society of France, especially established to find a solution to this problem. This calendar is perpetual.

As our president, M. Arm. Flamache, has observed in his study of the question which he presented to the Belgian Astronomical Society in 1908,[2] the Armelin plan has the great fault of disarranging the regular course of weeks of seven days, and that fact is sufficient to put it in popular disfavor. We think that this objection is altogether reasonable.

M. Flamache keeps the week and the 12 months; in his system the months have successively 30 and 31 days, and December, which has 30 days in ordinary years, has 31 in leap years. Clearly the calendar is not perpetual in this case.

In all these plans the year begins, as at present, on January 1.

---

[1] *La Meteorlogia prattica*, No. 2, 1922; No. 3, 1926.

[2] *Bull. Soc. Belge d'Astr.*, 1908, pp. 105, 136.

M. Deslandres proposed to begin it at the winter solstice, on December 22, and it is to be hoped that this will be adopted.

Professor Grablovitz has just submitted to the committee of the League of Nations a new plan of which he is the author and the principle of division of which he has applied for 30 years to the meteorological year and to the study of atmospheric conditions. His year begins in March and includes the four ordinary seasons of three months each, the months being alternately of 30 and 31 days; the month of February has regularly 30 days, and 31 days in leap years. If this system be adopted, there naturally will be a transition year having 14 months, but it is seen that this year of Grablovitz is a true representation of the year of Flamache.

The main idea which has guided M. Grablovitz is to link the calculations of meteorological averages with the true solar year which determines the seasons, for under present conditions the beginning of the year divides the winter into two parts. This is the reason for which he makes the year begin in March; then the quarters correspond to the seasons.

The historical reviews on proposed calendar reform oblige us to state that before the question was finally taken up before the League of Nations, three particular groups were busy with it in recent years. M. Armand Baar, in the interesting lecture which he gave us in 1923, related their history, which may be found in our Bulletin for 1923, pp. 146 and 164.

The first of these conferences was organized by the Belgians and was held at Liege in 1913; it was composed of astronomers, of clergy (for the problem of movable holy days was raised as well), and of representatives from chambers of commerce. At Paris, in 1914, these decisions were submitted to the Congress of International Chambers, which adopted the system of twelve months with the supplementary days. Easter was fixed on the first of April.

Finally, the Congress at Rome, in 1923, approved these decisions and adopted, in addition, the proposal of Deslandres to fix the beginning of the year on December 22, the date on which the days begin to increase in length.

Probability of Injury by a Meteorite. — To those who have not given thought to the question, it is somewhat surprising to learn that reliable estimates place the number of meteors, which are bright enough to be visible each twenty-four hours, well into the millions. To be sure, many, doubtless most, of these are consumed in the atmosphere and reach the surface only as finely divided meteoric ash. However, it would seem that, the world over, the number of meteoric fragments which strike the surface of the earth must be very great. However, recorded instances of persons or animals being injured by such fragments are exceedingly rare. Professor W. H. Pickering in a paper on "Meteorites and Meteors"[1] states that only two fairly authentic accounts of any one having been killed by meteorites are extant; the one in the Book of Joshua X, 11; the other concerning a fatality at Mhow, India, in 1827.

In consideration of these facts, the following letter, just received, is of great interest and significance. It is printed practically as it was written.

A Little Meteor Hitting a Person.

A few days ago, Mr. Sei-iti Yanagimati, a friend of mine living in Aba village, Ibaraki-ken, about 65 kilometres NNE. from Tokyo, sent me a little meteor with his personal letter in which he stated the details of

[1] Popular Astronomy, **27**, 206 (1919).

the fact and the circumstances of the fall of the meteor. He writes that the meteor fell on April 28, 1927, at about 9 A.M., Japanese Central Standard Time (9 hours in advance of Greenwich Civil Time), at Mr. Kuriyama's house in Sukatu village of the same district. Curiously the meteor hit a young girl, Chiu by name, Kuriyama's second daughter, three years and six months old, on her neck. Her sudden crying was noticed by her mother, who was the only person then at home. She found that the child was hit in two places: one of them was a mere scratch, while the other was a somewhat severe burn and took several days to disappear. At first the mother could find nothing as a probable explanation of the accident which caused the innocent child's sudden shrieking in this peaceful country life, but after a careful examination about the child the mother eventually found a tiny little stone coming out of a fold of the child's clothes. This was the present meteor, which was felt by the mother to be more or less hot. Two days later the meteor was brought to Mr. Yanagimati, the principal of the primary school there, who kept it for a while as a sample for education. Upon receiving the object recently from Mr. Yanagimati, I showed it to some of my colleagues in the University Observatory who joined me in further examinations. The meteor is 0.75 cm. x 0.5 cm. x 0.3 cm. in size, and weighs about 0.19 gram, so that this may be one of the smallest meteors ever found in an independent fall. The appearance thereof is that of the usual meteoric stones, and about half of its outside surface is covered by black crust while the rest shows a fresh rough surface caused by a probable breaking while moving in the sky. Chemical and microscopic examinations have not yet been made.

I think this may be really a rare example of meteoric falls which actually attacked the human body causing positive disasters on him. So far as I know, this is the only case of this kind.

We call this object "Aba" Meteorite.

ISSEI YAMAMOTO.

Kyoto University Observatory, January 31, 1928.

Brilliant Meteor.—A more detailed account of the meteor observed by Wm. H. Schroeder, referred to in "Meteor Notes" (p. 188), follows:

On February 12, at about 7:30 P.M., C.S.T. (possibly ten or fifteen minutes sooner or later) the evening being clear and moonless, Son Gibbs (age 12) and I were at the telescope viewing λ Orionis, when just after leaving the eyepiece, a meteor came into view, surprising us so with its suddenness and brilliancy that we almost lost the degree of coolness required for observation close enough to justify a report. However, the following is we believe, after close checking, a fair approximation of the circumstances.

The object began to glow about midway between θ and κ Orionis, took a course slightly west of south, brushing past and a little to the right (west) of α and β Leporis, and then slackening its speed somewhat swerved a little to the right, diminishing in brightness, but apparently regaining its former speed for a moment at least, and became extinct in about the vicinity of ten or twelve degrees to the right of α Columbae. The first half of its flight was a straight line, the last slightly curved. Time visible about four seconds. The color range seemed considerable, coming in reddish-blue, turning to whitish-blue about half way through its flight, and becoming dull red just before extinction. We feel there was no trail for about the first half of its flight, but agree after that a trail about one-half degree in length developed. A small piece separated from the main body a moment before the disappearance. The speed seemed moderate as compared with other meteors, but its brilliancy was truly impressive, for at its brightest moment I believe it reached three or four times the brightness of Venus when it is at its greatest brilliancy. I am wondering if others who witnessed the phenomenon were impressed in the manner we were, and if there is some agreement about our observations. I should be glad to hear from anyone interested and be-

lieve comparisons made from different points would prove instructive.

WM. H. SCHROEDER.
6540 Fifth Ave., Kenosha, Wis., February 12, 1928.

A Correction.—Our attention has been called to a systematic error on page 47 of the January issue of this year. In the remarks concerning the planet Neptune, instead of "eastward" one should read "westward" and for "retrograde" one should read "direct," in order to get the correct meaning.

BOOK REVIEWS.

Publications of the Yerkes Observatory, Vol. IV, Part VI and Vol. V, Part I. — The University of Chicago Press, Chicago, Illinois. Price $1.50 and $3.00.

The first of these contains an account of the work in Photographic Photometry done by Professor John A. Parkhurst on the stars in the 24 Kapteyn areas at declination +45°. The observational material consisted of 472 plates taken with three telescopes between 1914 and 1921, and includes a total of 1550 stars, for each of which the photographic and photovisual magnitudes, with the resulting color-index, were determined. The final work in preparation of the material for printing was done by Miss Alice H. Farnsworth after the death of Professor Parkhurst. There is an introductory note by Professor Edwin B. Frost.

The second contains the results of the work of Professor George Van Biesbroeck on the measurement of double stars during the past eight years. It is the fifth publication by Professor Van Biesbroeck of a similar nature. This one is concerned chiefly with a remeasurement of those discovered by Professor Hussey, more than 1300 in number. In addition to these, Professor Van Biesbroeck measured a considerable number of pairs from various catalogues, especially those which had not been measured for some time, and those which, because of their difficulty, require instrumental equipment such as the Yerkes Observatory affords. The arrangement of the observations is similar to that of Part II of Burnham's *General Catalogue of Double Stars*. It comprises 265 pages, quarto size, and constitutes a valuable addition to the literature of double star work.

Contributions From the Mount Wilson Observatory.— A series of these "Contributions" treating a variety of subjects, all interesting and of great importance in the development of astronomy and astrophysics, has recently been received. They are the following:

No. 328. A study of the infra-red solar spectrum with the interferometer, by Harold D. Babcock.

No. 329. Measurement of the velocity of light between Mount Wilson and Mount San Antonio, by A. A. Michelson.

No. 330. The short-period variable star RV Canum Venaticorum, by J. Schilt.

No. 331. Interstellar calcium, by Otto Struve.

No. 332. The motions of giant M stars, by Gustaf Strömberg.

No. 333. Spectrographic orbits of the two components of Boss 5683, by Roscoe F. Sanford.

No. 334. Stars whose spectra have bright iron lines, by Paul W. Merrill.

No. 335. The nebulous envelope around Nova Aquilae No. 3, by Edwin Hubble and John Charles Duncan.

No. 336. Transmission properties of some filters, by Edison Pettit.

No. 337. On the spectra of doubly and trebly ionized titanium (*Ti* III and *Ti* IV), by Henry Norris Russell and R. J. Lang.

No. 338. Investigations on proper motion, by Adriaan van Maanen.

Other Worlds, by O. J. Schuster. (The Christopher Publishing House, Boston. Price $1.50).

In this book of 104 pages the author has attempted with marked success to present the most obvious items of present day astronomy. By the device of a magical ship as a stimulus to the imagination, he in thought transports the reader into the presence of the elements of the cosmos which he describes. He thus makes the facts stand out so vividly that they are sure to leave their impression upon the mind. The book may be read at one sitting, and upon finishing it the reader will feel that his comprehension and his appreciation of the physical universe have been greatly enlarged.

The North American Almanac for 1928.—(The North American Almanac Co., 415 W. Chicago Ave., Chicago. Price fifty cents.)

This is the eighth consecutive year for which this almanac has been provided. The almanac has steadily increased in size, this latest number containing 156 pages. It has increased not only in size but in interest and value. It is free from the fantastic and unreliable material sometimes found in almanacs. It contains comments upon many topics in addition to those directly connected with the science of astronomy. The sources of its material are thoroughly dependable, and one may confidently turn to it for information on a variety of subjects. The reviewer noted one unfortunate typographical error on page 126. The number of miles in the distance represented by a "light-year" is ten times as great as is there given.

Leitfaden der Astronomischen Beobachtung, by H. J. Gramatzki; Ferd. Dümmlers Verlag, Berlin S W 68; 3.50 marks.

This is a small volume of 111 pages, furnishing, as the title states, a guide in making astronomical observations. The author proceeds from the valid premise that what one has experienced leaves a more vivid and lasting impression than what one has merely been told about. Consequently the approach to astronomical study should be through observation, even though it be of a very simple character. This work summarizes the salient facts of astronomy and gives explicit directions for observing in practically all of the fields of astronomical and astrophysical science. The book can be recommended to the amateur for whom the German language is intelligible.